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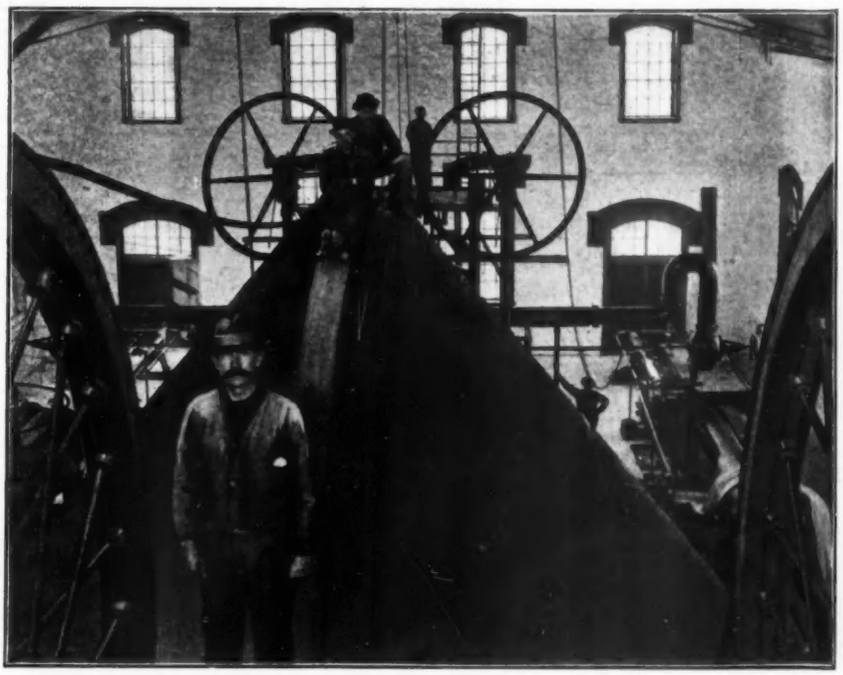
Machinery of the Copper Mines of Michigan.

BY CHARLES P. PAULDING.

From the Upper Peninsula of Michigan there projects northward into Lake Superior a small peninsula, called on the map Keewanaw Point. This is the "copper country" of Michigan, and its backbone consists of a trap rock containing veins of copper-bearing amygdaloids and conglomerates. The copper is pure, and for the most part occurs in very small particles, although large masses are sometimes found. Rock containing four per cent. of copper is considered very profitable.

As all the veins have the same inclination, about fifty-two degrees, and do not vary greatly from a thickness of about twenty feet, the mining is of the simplest character, and only two methods are in use throughout the region. These differ only in the fact that in one method the shafts are sunk vertically, intersecting the vein at about the middle of the property, and connecting with the vein above and below the point of intersection by horizontal passages perpendicular to the vein, called crosscuts. In the other methods the shafts start where the vein crops out on the surface, and are sunk with the same inclination as the vein thus lying wholly within it. The latter method is considered the most economical. In both methods horizontal passages called levels are driven along the vein about every hundred feet in depth, and the ground worked out or "stoped" from each level up nearly to the one above it. When inclined shafts are used, these levels evidently connect them; but with vertical shafts, crosscuts are driven over to the shafts from the levels. In most of the mines the shafts and levels are very solidly timbered, and as the ground is stoped out above a level, timber has to be put in.

The underground machinery consists of rock drills, small portable hoisting engines and pumps. The drills are run by compressed air at from 60 to 70 pounds pressure, and the air thus liberated forms an important factor in the ventilation of the mine. In fact, it is a common practice for the men to allow the air to blow out into the mine when the drills are idle, during the meal hours, and to such an extent that the compressors have to furnish a greater volume of air at this time than when the drills are working. In case electric drills were used, the amount of the artificial ventilation by fans would have to be considerably increased, but one would suppose such ventilation much cheaper than this use of compressed air.



HOISTING DRUM.

After the rock has been gotten out by blasting, it is loaded on tram cars, which are pushed along the level to the nearest shaft, where they are dumped into the skip, as the car in which the rock is brought to the surface is called; or, in case of vertical shafts, the tram car is run by a crosscut to the shaft and run directly onto a framework in which car and rock are both hoisted to the surface. The two half-tones, Figs 3 and 4, show these operations.

A great many small hoists consisting of a drum operated by two cylinders about 6 x 6 inches, and driven by compressed air, are used underground for hoisting timber up in the stopes, moving tram cars, or sinking the shafts a little deeper from time to time. They must be very compact, strong and simple, for machinery underground receives the hardest of treatment.

Most of the mines in this region are fairly dry, and the pumping plants are not extensive. The water from a considerable portion of the mine will be caught in a sump at one place by natural drainage, and the aid of a few small direct-acting pumps, driven by compressed air. A duplex compound direct-acting pump, driven by steam, will lift the water from the sump and force it some 500 feet up to another sump, from which it is taken by a similar pump and forced another 500 feet, and so on to the surface. These pumps have each an independent jet condenser, and the condensed steam is pumped up with the mine water. The pumps work against a head of about 230 pounds, and under these conditions and a steam pressure of 120 pounds, a pump of this type with water cylinders 7 by 18 inches, and

making thirty double strokes of one side per minute, will show a duty of between thirty and forty million.

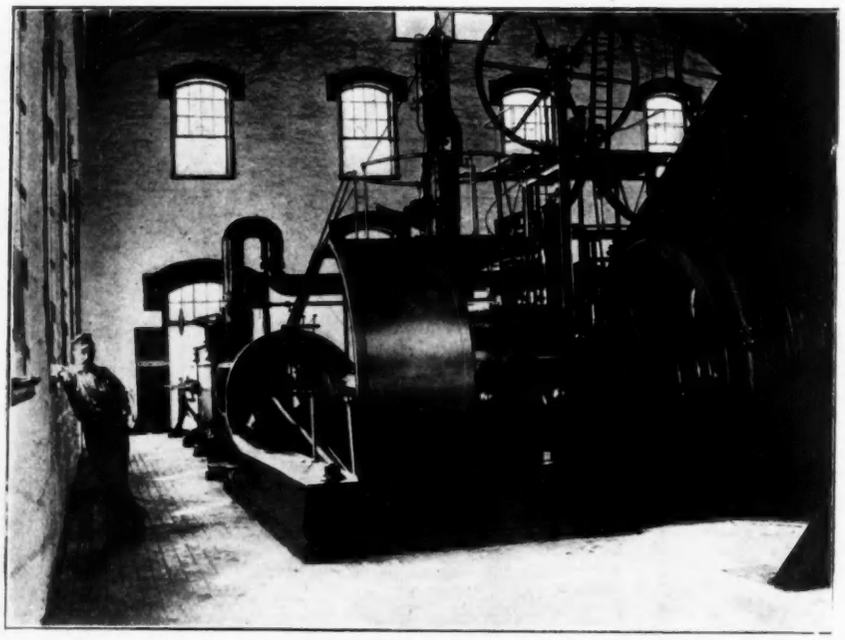
The use of steam for this work is very objectionable, it rots the timbers in the shaft, the loss by condensation in the steam main is a large item when the pipe is three-quarters of a mile long, as it is in some of these mines, and the condensed steam heats the water to a point at which its corroding action on the column pipe is something remarkable. This last effect is hightened by the frequent presence of sulphuric acid in the mine water.

Either compressed air or electricity could probably be made to do this work more satisfactorily and economically, especially now that the use of electricity underground has been so thoroughly developed in coal mining. However, the service in these mines is especially severe on account of the long lifts, and also because when the snow melts in the spring the water comes with a rush and the pump, whatever it is driven by, must be capable of being worked to the limit of its capacity day and night, without danger of its breaking down.

Turning to the machinery on the surface we find little of note in regard to the boiler equipments. They are mostly locomotive boilers, fired in many cases with wood. From 7,000 to 9,000 pounds of water are evaporated per cord of wood. The coal used comes by water from the Pittsburg and West Virginia fields, and will evaporate about 8 pounds of water per pound of coal under fair conditions.

The most important machines of a mine are the hoisting engines, and the prevailing type here is a pair of simple engines on the same crankshaft, this crankshaft carrying the hoisting drum. The valve gear is generally of the Corliss pattern.

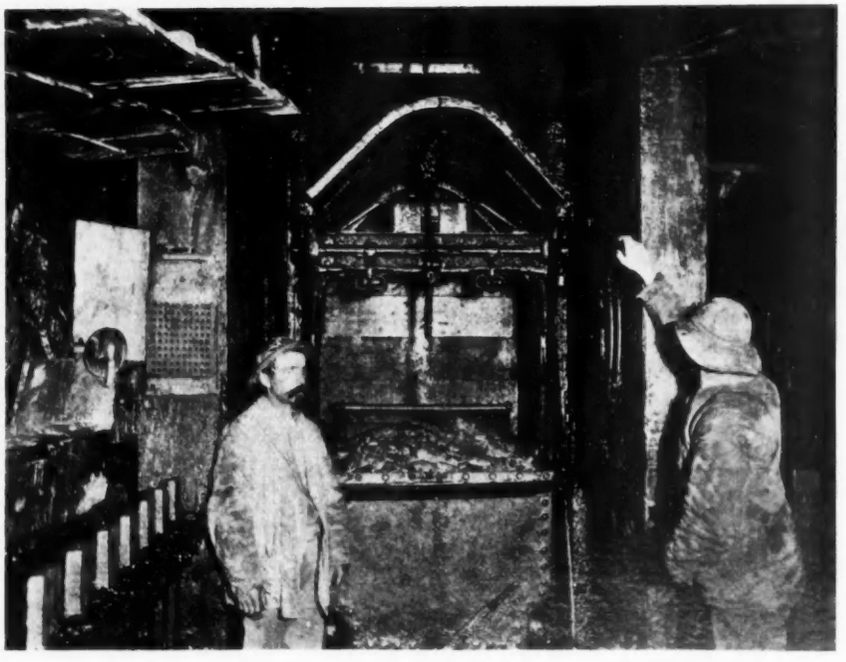
In vertical shafts the drum carries two ropes, and one cage comes up as the other goes down, thus securing a partial balance. As vertical shafts are only used here when some other company owns the upper part of the lode, these shafts are generally fully three-quarters of a mile deep, and in consequence the engine has to start, besides the car and rock, a weight of rope of about five tons. To overcome this, many of the engines are fitted with conical drums, the engine starting the load with the rope at the small end of the drum, where the engine has the greatest leverage and the load the slowest speed; as the weight of rope hanging in the shaft grows less, the speed of the car increases, the work of the engine remaining nearly uniform. Figs. 1 and 2 show one of the latest engines of this type.



HOISTING ENGINE.

The speed of hoisting in vertical shafts is frequently as high as 2,500 feet per minute; in the inclined shafts it varies from 1,100 to 2,000 feet per minute. In hoisting skips containing five tons of rock, wire rope 1¼ inches in diameter is used. The rope is made of "plough steel" wire, a term which merely signifies wire of the best steel. It may be interesting to see what the strain on these ropes is. Take the case of a 1¼-inch rope hoisting 5 tons of rock from a depth of 5,000 feet on an inclined shaft. The weight of the skip is, say, 3¾ tons; of the rope, 2½ pounds per foot. This gives a total weight of 15 tons; but as the angle of the shaft is about 50 degrees, the strain on the rope at the top of the shaft is 9 tons, nearly 15,000 pounds per square inch of section. This, of course, does not include the resistance to traction of the skip or the pressure of air against the front of the skip, which in a shaft, with the skip moving 2,000 feet a minute, must be considerable.

It is also interesting to note how small a proportion of the work done in hoisting in deep mining is what is called "useful work." Take the case given above to illustrate the great strain on the rope. We have there lifted 10,000 pounds through 5,000 feet, and this is the useful work. To accomplish this we have also lifted 1,000 + 7,500 + $\frac{7,500}{2}$ = 30,000 pounds through the same distance. If our hoisting apparatus had no friction this would give

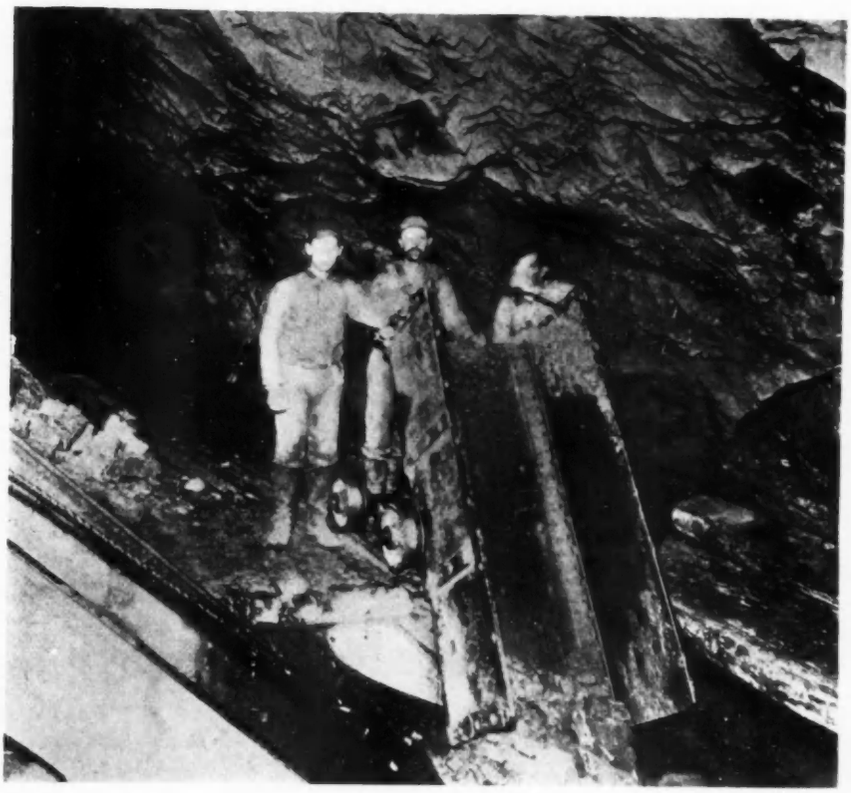


THE SKIP.

us an efficiency of 33⅓ per cent.; but our hoisting apparatus has an efficiency of very close to 80 per cent., so our final efficiency is .80 × .33⅓ = 27 per cent.

In the best practice here, each shaft house has its outfit of rock crushers, and the rock is reduced to small pieces of such a size as to be ready to go directly to the stamp mills, where it is crushed to powder, and the rocks washed away from the heavier copper.

The skips used in the inclined shafts are self-dumping, this being accomplished by making the treads of the rear wheel much wider than those of the front wheels, so that when the skip is at the top of the shaft and in the shaft house the front



DUMPING THE ORE.

wheels follow a track curved down in the arc of a circle, the rear wheels remaining on the inclined track broadened out at this point to allow the front wheels to pass through. The bale to which the rope is attached hinges on bearings nearly over the rear wheels, and the skip revolves down until its bottom is vertical. At this point the hoisting engine is reversed and the skip starts back down the shaft.

Meanwhile the rock has fallen out onto an inclined grating of iron rails, the largest pieces rolling down this to a rock crusher, into which they are fed by a couple of men. The discharge from this crusher and the rock that has passed through the upper grating and has been intercepted by another grating beneath, are then fed into a smaller crusher, and finally fall into bins from which they are loaded by gravity into cars.

The two crushers are driven by small steam engines, which, on account of the very sudden variations of power, should be of high speed and provided with very heavy fly wheels. A shaft house with crusher capacity for 50 tons per hour of this hard rock, will need an engine capable of indicating 60 horse power; but this engine will run most of the time at about 20 horse-power, as the calls for greater power are only of momentary duration, when an extra large rock is in the upper crusher.

There is little of note concerning the air compressing plants. The air pressure is never over 70 and so, rightly enough, no one uses two-stage compressors. All the compressors are duplex and a considerable number compound condensing.

The rest of the surface plant consists of a number of small engines driving machinery in machine, carpenter, and blacksmith shops, and one or two large ventilating fans. There is little doubt that this service could be rendered much more economical by electric motors, especially as nearly all the mines have electric lighting plants for the surface.

From the shaft houses the rock goes to the stamp mills, located on the small lakes which open out into Lake Superior. The machinery here is of too special a character to be of general interest. From the mills the copper, now reduced to coarse sand, goes to the smelting furnaces, where the very small percentage of impurities is gotten rid of and the copper is cast into ingots.

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Water Required for a Condenser.

BY W. H. WAKEMAN.

My attention has been called to this subject in several ways within a short time, for there seems to be much difference, in some cases at least, between the amount actually needed and that called for by what is apparently a common-sense rule for this purpose. What causes this difference is the point to be settled.

Rules given us to determine the amount of water needed, usually give the result in the number of volumes required, or, in other words, the number by which the quantity of water used in making the steam must be multiplied. In order to arrive at the number of pounds needed per hour, we must calculate on the pounds accounted for by the indicator per horse-power per hour. From this it will be apparent that the rule for the amount of condensing water required is divided into two parts, and if we can determine which of these parts contains the greatest error we shall have made one step in the direction of solving the problem. The result given below shows the amount of water actually required to condense a given amount of steam.

The experiment was made with a device resembling a surface condenser on a small scale, for the steam was conducted into a closed vessel, and through this vessel a pipe was passed so that cold water could be run through it to condense the steam. In this way the whole of the steam condensed was caught and weighed, and the water required to condense it was also carefully weighed. By dividing one by the other the volumes could be accurately determined. When this was done, the result was found to be just 50 volumes.

Let us apply the rule and note the result:

$$\frac{T-t}{t-t''} = V, \text{ in which}$$

T = the total heat of the steam at the observed pressure;

t = the temperature of the condensed steam;

t' = temperature of the condensing water when it leaves the condenser, and

t'' = the temperature of the condensed steam before it enters the condenser.

During the test referred to, the temperatures were taken at ten different periods, and the results given are the averages, so that if any error exists, it will be very small. Applying the formula gives the following:

$$\frac{1203.5 - 97.34}{73.4 - 49.91} = 47.1 \text{ volumes.}$$

This shows a difference of but 2.9 volumes between the theoretical calculation and the result obtained by direct experiment.

and in such a case we would take the latter as correct.

If we were to calculate the amount actually required, our next step would be to determine the number of pounds of water accounted for by the indicator and multiply one by the other. Much dissatisfaction seems to exist, however, among engineers concerning the value of rules given for the latter purpose; and inasmuch as more water is needed to run a condenser than this rule, as a whole, calls for, it may be of interest to know in which part of it the error exists, and this report certainly shows that but a little of it can be traced to that part which tells us how much water will be required to condense a given amount of steam, therefore it must be largely in that part which is supposed to determine the amount of steam to be disposed of.

In this case the steam was not taken from the exhaust pipe of an engine, therefore the rule for determining the amount of water required to furnish steam for an engine under stated conditions, could not be tested for correctness.

It is a well-known fact that much of the steam that goes to the engine is disposed of by cylinder condensation, and if we take the terminal pressure of the indicator diagram and assume that it is all dry steam, we shall have a quantity of water to reduce to the temperature of the hot well, which will not be represented in our calculation; hence much more water will be needed than the rule calls for.

Some of our engine builders have made tests in which all of the steam passing through the engine was condensed in a surface condenser, so that the exact amount could be determined, and when this was compared with the amount determined by the rule the difference could be accurately known. If more of the results of such tests were published, it would be of much interest to engineers and others.

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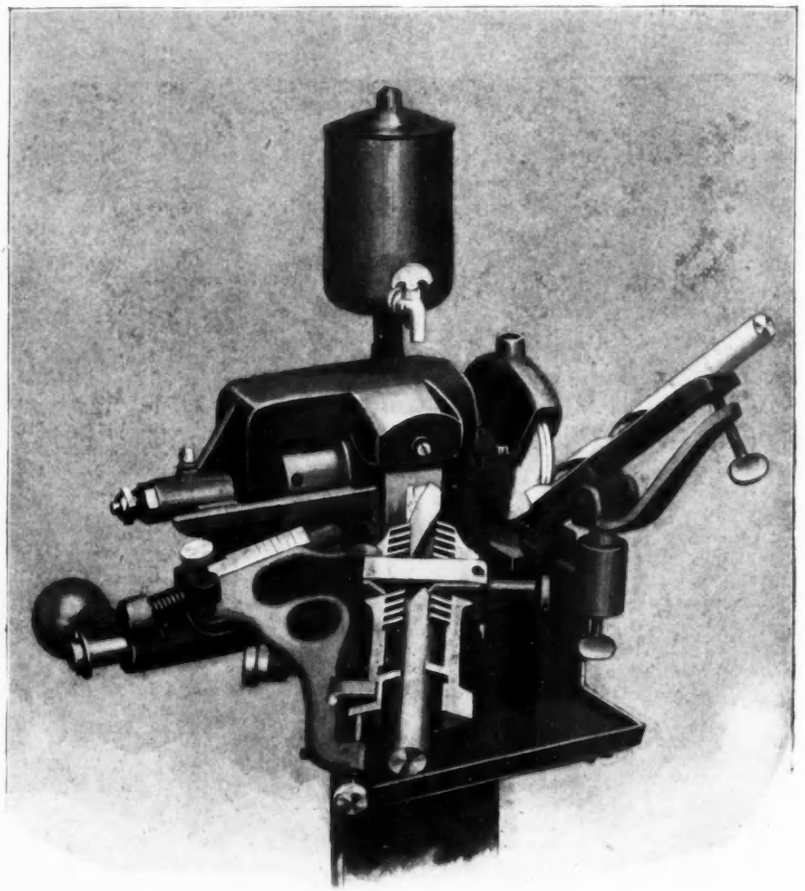
Twist Drill Grinder.

We illustrate herewith a twist drill grinder, which has just been placed on the market by the Garvin Machine Company

The aim of the designer, Mr. R. Dutton, has been to imitate the process and result of hand grinding, and to provide a mechanical drill holder and suitable guides for the same, so that the inaccuracies of hand grinding are done away with. Equality in the length of the lips is insured, as well as equal clearance to both lips. This clearance is properly graded to suit the size of drill being ground, and means are provided for bringing the second lip gradually to the wheel, no matter how heavy the cut on the first side may have been. The grinding is done upon the face of the wheel instead of its side. The drill, after being clamped in its holder, is moved back and forth across the wheel, and being positively guided in this movement, accurate grinding results, while comparatively uniform wear of the wheel without formation of ridges is insured. This guided movement of the drill in grinding is also correct for a diamond tool in trueing up the wheel, and the method followed in trueing the wheel, is to insert a common diamond tool having a round handle for hand use in the drill clamp or chuck, and move it forward and backward over the wheel precisely as the drill is moved in grinding. A forward and back adjustment of the entire head carrying the emery wheel shaft is provided, the purpose of which is to provide for wear of the wheel. After trueing the wheel, or after appreciable wear from use, it is adjusted by this means and by means of a straight edge, the wheel being brought up to its proper position in line with the guide bar.



THE DUTTON TWIST DRILL GRINDER.

The drill holder or clamp, as will be plainly seen in the illustration, embraces the drill in a manner similar to the "Little Giant" drill chuck. The drill is inserted in this clamp without binding it, and is then drawn through and adjusted fair with the guide bar seen at the left and in line with the center of the wheel. The yoke surrounding the clamp is then tightened. For small drills, the clamp is held in place by hand, but a knurled binding nut, seen at the left and near the round thumb hole, is provided for use in grinding large sizes.

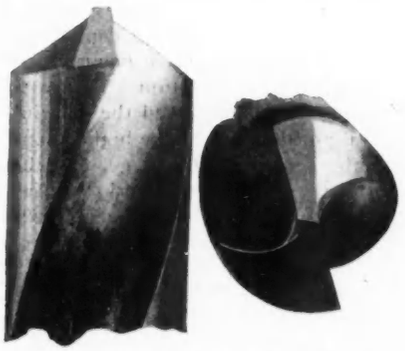
Coming up vertically, and resting against the face of the guide bar, will be seen the cam guide, and in front of it will be seen a figured scale, which represents the diameter of the drill in eighths of an inch. This cam guide determines the angle of clearance, and is set to the proper figure for the drill being ground. The screw stop, for insuring equal grinding of the two sides of the drill, will be seen at the outer end of the drill clamp. It abuts against the clamp—not against the drill, which, if long, passes through the clamp past the stop. After grinding one lip, the drill with its clamp is removed and turned over, which operation brings the drill in proper position for grinding the second lip.

The shape of the parts, together with the convenient thumb hole, provides for convenient grasping by the right hand. The left hand grasps the balance ball shown behind the machine, and the grinding is quickly done. The guide for the movement of the drill in front of the wheel is a round horizontal bar seen projecting at the left, and around on it the clamp and drill swivel as well as slide—this swiveling motion being used to bring the second lip gradually to the wheel, and also to back off the hinder side of the lip. The swivel motion is free so far as depressing the drill is concerned, but is

limited in the opposite direction by the cam guide already described, thereby insuring equal presentation of the two lips to the emery wheel.

The center grinding attachment is seen at the right, and its general method of action needs no explanation. It should be noted, however, that a guiding finger is provided at the lower end of the drill, by which equal grinding in the two lips is insured.

A water pot will be seen over the machine, which is so mounted as to deliver the water to either wheel as desired. A catch pan will also be seen below, to which a pail is hung, the pan being of such size and shape as to cause the sediment to be deposited in it, so that the water in the pail is kept comparatively clean. The catch pan is so placed as to catch all the



SHAPE OF DRILL WHEN GROUND.

drip and prevent the water from making a mess on the floor.

The second illustration will show the form to which the machine grinds the drills, including the grinding out of the center. The backing off of the rear side of the lip may be increased beyond what is shown, if desired, or, if preferred, the grinding may be on the usual lines in one continuous curve up to the cutting edge.

The chuck shown takes all drills from ¼ to 1 inch, inclusive, and a smaller chuck takes drills down to the smallest.

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Bursting fly-wheels have been infrequent of late. On March 24th, about midnight, the engine in mill No. 2 of the Edgar Thomson Steel Works ran away and the 24-foot wheel burst, fatally injuring the engineer and another man, and doing great damage to the mill.

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The elasticity of steel increases with its hardness. A device based upon this fact is used for testing the hardness of steel balls, and separating them accordingly. The balls are dropped one by one from a given hight upon a slightly inclined heavy glass plate. The hardest balls, being most elastic, rebound and reach a pocket provided for them, while the softer and less elastic balls fall short and drop into another pocket.

Pattern-Making Bench Tools.

BY JOHN M. RICHARDSON.

I have on several occasions in the past, dwelt at some length on the machine tools used in a pattern shop, and now I will confine myself wholly to those tools that the workman can own himself as his kit or equipment. It would be a hard matter to name a trade where so great an outlay for tools is expected of the workman himself, as in pattern making. When a workman enters a new shop, he finds only a bare work bench. Whatever he uses in the way of tools, he must furnish, and the better workman he is, as a rule, the more and better tools he will have.

This desire for new tools is a sort of ruling spirit in the true pattern maker, as long as he follows the vocation, and, for the benefit of apprentices and others who may be thinking of selecting tools, I shall mention those especially useful in pattern work.

Planes: The day has gone by for the old, clumsy wooden planes for fine work. The iron planes are almost wholly superseding them in the hands of up to date workmen, for they hold their shape better, and the cutters are so easily adjusted. The best planes have two motions, one to raise and lower the iron, and one, a lever, to throw the cutter sideways to ensure a chip of even thickness. A jointer about 22 inches long, with a 2⅜-inch cutter, is the size usually found on the pattern maker's bench, together with a smooth and block plane, and sometimes a fore or jack plane.

The other planes used are the circular plane, and rabbet, round and core-box planes. The circular plane is very useful on large, curved surfaces, either concave or convex, as the base, or "shoe" is flexible steel, and can be quickly adjusted to conform to an arc either convex or concave. Rounds come in handy oftentimes in planing out large fillets and curved parts of patterns. Rabbet planes are made in both wood and iron; the wooden ones have the iron set sometimes square, and sometimes angling. The latter, I think, is preferable, especially when planing across the grain, but I have never come across an iron one so fitted. Core-box planes for half-round straight core boxes can be bought, but are not very common in stores, and the workman usually makes his own. An old rabbet plane can be quite easily converted into one, by fitting on a wing at right angles to it. This kind of a plane is quite a conundrum to one who has never seen one, and really reflects great credit on the original inventor, whoever he may have been, as it is based on the principle in geometry that any number of right angles can be contained within a semi circumference.

A spoke shave can hardly be called a plane, still its action is similar, and some form of it is indispensable. There are many varieties, and many patented forms of more or less merit, with different shapes of body and clamping devices for the cutter. There is one kind, more properly called a scraper-shave, that does beautiful work when properly sharpened; but that is the difficult part, for there is quite a knack in doing this. The cutter is a piece of saw plate, and sets in the stock or handle, so that it is nearly perpendicular to the work, instead of on a bevel, as in an ordinary spoke shave.

Chisels and Gouges: These are among the most important of pattern making tools, and as they are expected to be pushed instead of hammered into the work, they are known as paring chisels and gouges, and are longer and more slender than those meant for heavier work. Beveled edge chisels with tanged instead of socket shanks are preferable, as they are less clumsey, and there is just so much less stock to be ground away on the stone, and at the same time there is exactly as much wear in the tool.

Paring gouges are commonly found in three different sweeps or curves, known as flat, middle and regular. It is hardly necessary to buy a complete set of each sweep, for a judicious selection, representing a good combination of curves, that will embrace about any radius likely to be encountered, is usually sufficient, and even if there are not many more in number than would compose one full set, still the range of usefulness is far wider.

The gouges just mentioned are supposed to be inside ground, and a few outside ground are necessary in addition. Certain forms of bent shank carving gouges of varying widths and sweeps are like an oasis in the desert when some peculiar shape is required to be cut away, which it is almost impossible to get at with any common form of gouge. The same comment I made regarding the shanks of chisels is equally applicable to all gouges. Some pattern makers may prefer the socket style, but it seems to me they are better adapted for heavier work, where a mallet is required.

Bit Stock and accessories: A first-class ratchet bit brace is of prime importance, and a set of auger bits should be selected, having as long and slender lips as possible opposite the spurs, and some of the commonest sizes of these patent bits which can he placed directly over a circle laid out with dividers, and a hole bored, leaving no center, and having a flat bottom, are something that are of the greatest usefulness on fine pattern work.

For small holes, say from $\frac{5}{64}$ inch down to the smallest size, bit stock drills are very useful for they will bore anything with which they come in contact, a nail, for instance, doing no serious damage.

The lips on these when used for wood should be ground to an angle of about 90 degrees, which is a much less angle than they have when bought.

A rose countersink for screw heads is about as good as any, for that too can be

used on metal as well as wood. A large and medium screw driver bit must also be added, and extension bits covering every size from ½-inch to 3 inches, will prove useful very many times, especially so when boring for draw plates.

Other pieces for the bit brace, like a dowell-pin pointer, plug cutter and washer cutter, reamer, etc., almost always come in play sometime or other. A plug cutter ½ inch in diameter is really very useful, for it is as quick and neat a way as there is to cover a screw-head on a pattern, and many plugs can be made in a short time, boring them from ¼-inch stuff, when they come from the piece looking like a lot of little bungs.

A router is a very necessary tool, and comes in play every time a draw plate is put in a pattern or any piece is let in a given depth, and is in its action what might be termed a depth plane, for it planes the bottom of the depression being worked out, to a dimension constantly parallel with the upper surface of the work.

It might not seem, at first thought, that pliers and nippers would be needed, but it is surprising how often they have to be used. A bench knife, with a blade of fine steel that will hold an edge, is indispensable, and another with the blade sharpened on both edges from one side only, and then bent into a curl at the end, is of the greatest use in paring out corners and places where one cannot whittle with a straight blade. A putty knife with a flexible blade must not be forgotten, and some form of slickers are needed to put in wax and putty fillets. Some are made with a sort of spoon on each end, similar to one form of molders' slickers, and some have a straight shank in a handle, with a ball on the other end, with a radius equal to that of the fillet desired. This form has the great advantage of being able to work in a corner where three sides come together in a triedral angle. The simplest form on this principle is a rod of any diameter with a round end. Very small clamps do not always form part of the pattern-room stock of supplies, so a workman will always find a half-dozen or so of small ones, with 4-inch jaws, a valuable acquisition to his kit, when working on small work.

Several sizes of try squares are necessary. Those with adjustable blades are extremely useful, especially when squaring to some given depth, as on lathe work, etc. A long-bladed carpenter square is also wanted, but care should be exercised when selecting, in order to find one as near absolutely square as possible.

A bevel protracter I might also set down as a necessity, in addition to an ordinary bevel for angles, as drawings are so often figured in degrees, and the pattern-maker should not be obliged to place a common bevel over the lines to get the angle, for sometimes a drawing may not be made to scale, and then a figure would have saved the trouble.

As far as hammers are concerned, several sizes are useful; one large claw-hammer for heavy pounding, and a light one for bench work, and still another, with a long, slender head, to drive brads into deep recesses, is useful; while a good hard-wood mallet should not be forgotten.

There is one kind of saw that a pattern-maker seldom uses in the shop, and that is the rip saw. The circular and band saw take its place entirely. A cross-cut saw is, however, necessary to cut up boards with where they cannot be easily managed in the machines. A back saw and pad, or compass saw, should also be added.

The oilstone, if not a tool, still has the most intimate connection with almost every variety of tools, and too much stress cannot be laid on selecting one that has a good grit, and will produce a keen edge with the shortest amount of rubbing. A slip stone, with round ends, must also be used for keeping gouges in order. A block covered with leather is nice for putting on the finishing touches on a chisel or plane iron, and some workmen use a fine water-stone for the purpose.

A draw knife comes in handy to snag off corners on large work, preparatory to placing in the lathe. I do not consider it a necessity for a pattern-maker—merely a useful tool to have.

Two pairs of calipers, at least, will be found essential; one large pair of wing calipers, taking in 16 or 18 inches, and a small pair for light turning, etc. This pair can be either of the wing or spring or friction variety. By the latter term, I mean those held together by a rivet. The spring caliper is undoubtedly the best style, however. A pair of spring dividers is also needed for common work, and a little pair for fine spacing. For large circles use a pair of trammels.

Pinch dogs can be bought ready made, but are oftener found hand-forged by the shop blacksmith. These are used almost constantly for holding glued work together and for lathe work, when in halves, and, in fact, anywhere where clamping is necessary and clamps are not desired. A large and small screw driver are to be added to our kit, and where one can, a spiral screw-driver is a wonderful time-saver on work taking light screws.

Shrink rules can be had at almost any price from about 50 cents to $4. I strongly recommend the steel rules, because the workman can have so much finer and more accurate lines to go by. I do not decry wooden rules, however, for common work, and very many of them are very accurate; but they usually have no finer divisions than sixteenths.

The kind of gages that a pattern-maker finds use for are the scratch gage, panel gage, overhanging gage and surface gage. The first two need no remarks. The third is more on the principle of a scratch or marking gage, except that the scriber is a long, slender point, adjustable in the bar, so that when the stock or head of the gage is pressed against the side of the work, the long, slender marking point can reach down into recesses on the work, and over ledges, ribs, etc., and so get a parallel line.

A surface gage cannot be said to be a common tool among wood-workers, but no pattern-maker who has ever possessed one would be willing to do without. Very many patterns have hubs, bosses and core prints set at varying hights from the base, and often where it is next to impossible to locate them accurately by ordinary measurements. Now, what does the machinist do when he gets the casting on the planer? Why, he uses his surface gage to lay out all his centers with. Now, how much better it is for a pattern-maker to measure his work in precisely the same way, for where two different departments measure work in the same manner there is less chance for variation. To use the surface gage, simply stand the rule in a vertical position, set off the hight upon it with the scriber on the gage, and then transfer the point to the work, and it is merely play to get the line of a perfect hight all around, over every kind of obstruction or recess on the job, when all is placed on a perfectly flat surface.

The foregoing is not intended for a glossary of tools used in the trade, but by the time what I have mentioned have been procured, others will suggest themselves as need requires, and so the chest will continue to fill as time goes on.

▲ ▲ ▲

Safe Stresses for Stationary Engine Mainshafts and Crosshead-pins as Deduced from the Records of Experience.

BY HENRY HESS.

In England it is very largely the practice to insure against damage from engine failures, much as is here done with boilers. Mr. Michael Longridge, engineer to one of these companies, has made a practice of collecting data on the failures of various parts. Some of these are herewith plotted, with a view to the deduction of some lesson or law from this experience, extending over many years, with carefully inspected engines.

Diagram I is a plotted record of the failures of wrought iron crank shafts, built on the general plan of Fig. 1; the failures occurred in the neck or bearing. As regards the stresses, I quote Mr. Longridge: In calculating the stresses on the shafts of horizontal and vertical engines, the effect of the inertia of the running parts has been estimated and allowed for; and the table (omitted, but plotted as a diagram) shows the stress produced by the bending moment, equivalent to the combination of the actual bending and twisting moments when this equivalent moment was a maximum, generally at

about the point of cut-off. In the case of beam engines, the correction for inertia has not been made, and only the stresses due to the combination of bending and twisting moments are given. Although uncorrected, these stresses will be approximately correct, because the maximum stress in most cases occurred near the middle of the stroke, where the effect of inertia would be small; the actual stresses would probably not be smaller than 10 to 15 per cent. less than the amounts given.

"The equivalent of the bending and twisting moments are calculated by the usual formula:

$$M = \tfrac{1}{2} M + \tfrac{1}{2} \sqrt{M_b^2 \times M_t^2}$$

on the assumption that the pressure was applied at the middle of the crank pin, and that the shaft was supported at the middle of the bearing. The weight of the fly wheel has not been taken into account. This weight does not affect the

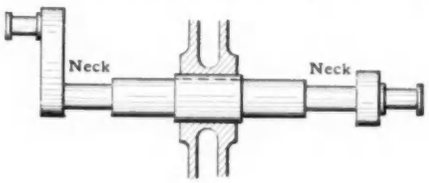

Fig. 1
STYLE OF SHAFT.

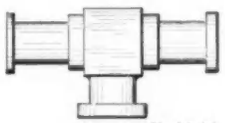

Fig. 2
STYLE OF CROSS-HEAD PIN.

calculated stress at the middle of the neck, but it increases the stress at the end next the wheel. For this reason, and also because it is quite certain that when an engine is at work the resultant reaction of the main bearing does not act through the middle of the neck, as it is supposed in the text books to do, the amounts given in the table (diagram) cannot be considered as more than approximations to the actual stresses."

Diagram I is plotted from Mr. Longridge's table, and gives the millions of revolutions made up to the time of failure, and the equivalent bending stress at the center of the neck or bearing. It will be noticed that all stresses fall between 5,000 and 15,000 pounds per square inch. An averaging line has been drawn in that will approximately represent the law of endurance. It conforms to the rational idea that the lower the fibre stress the longer the probable life. Within the limits given the law may be stated as

R is about .06 (11450 — S) where

R = million of revolutions before failure;

S = maximum combined tension and bending stresses reduced to equivalent bending stress.

The engines represented in these records are all to be classed as slow-speed, since the mean piston speed ranged from 340 to 500 feet per minute, with an average of 414.

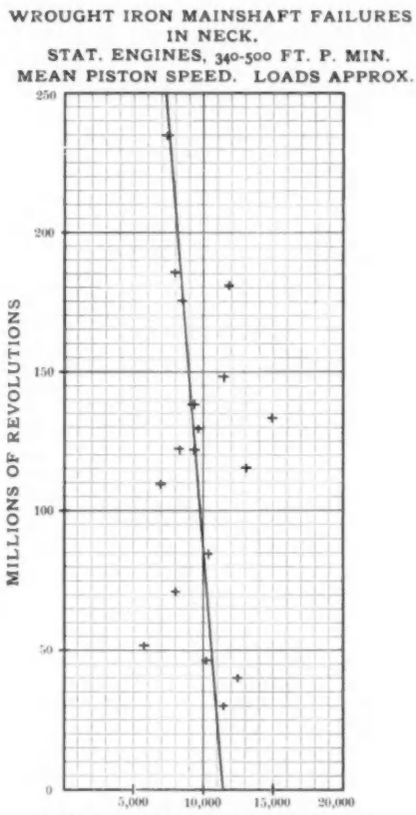

Diagram I

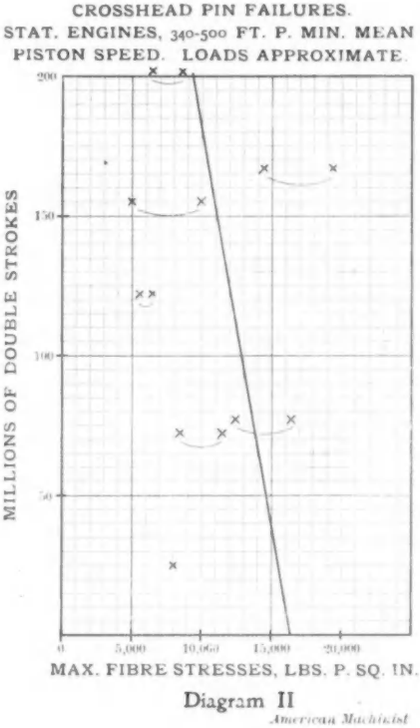

Diagram II

Diagram II is the plotted record of piston rod crosshead pin failures referred to maximum fibre stresses and millions of double strokes during life. The general type of the crossheads is shown by Fig. 2. In this case also the averaging line indicating the law of endurance conforms to the rational general one that the longer life will be had with the lower fibre stress. Where the points are connected with a ⌣ that indicates a variation between the stresses plotted. Unfortunately, the material of which the pins were made is not stated, but an assumption that a wrought metal having the general characteristics of a good machinery steel was in most cases used, is likely to be not far off the truth. Nor does Mr. Longridge state how he arrived at his stresses, but it is likely that he considered the pins as short overhung beams, in which case the figures given represent tensile or bending stresses.

The deductions may be safely drawn from these records of experience that—

In wrought-iron main shafts the greatest combined bending and tension stresses reduced to their equivalent bending stress, should not exceed 7,000 pounds per square inch;

In wrought-metal crosshead pins (of the type illustrated) the greatest bending stress should not exceed 10,000 pounds per square inch.

Both deductions to be applied only to slow-speed stationary engines having up to 500 feet per minute mean piston speed.

▲ ▲ ▲

A Convict Reformed by Mechanical Interest.

"I was an overseer of convict labor on the roads of a certain State in 1869, and had in my striped brigade a man of unusual mechanical talent—in fact, a wrong turn in the direction of his genius was responsible for the sentence he was then working out. The idea of being obliged to do the work of a common laborer, under strict surveillance, was so repugnant to his versatile nature that he had grown careless and sullen, and required constant watching. He had, however, attracted my attention from the very first, and whenever an opportunity occurred to turn his skill and knowledge to account, I was not slow in utilizing it, being very careful at such times to note the self-satisfaction with which this fellow turned from breaking stones to the task more to his liking. This was before the days of improved machinery in road-making, but prior to his discharge a stone crusher was added to the equipment of my force. He was perfectly capable of handling it, and was accordingly placed in charge. From the date of his 'promotion' henceforth to the last he was a changed man, and ultimately became one of the most cheerful in the force. After his release he went to Northern Illinois, started a new career, and is to-day, I believe, superintendent of a great steel mill in Chicago."—"Cycling Life."

Repairs of Electrical Machinery —VII.

BY A. R. HARRIS.

In the present article we will explain the mysteries of drum-wound armatures. The mystery is only imaginary, since this style of winding is simply an extension of the plain ring winding, but it perplexes almost every one who does not understand it, from the fact that, so far as appearances are concerned it is entirely different. By the aid of Fig. 1, the subject can be made quite clear. In this figure the coils *a b c d e f g h* are of the ring type and are connected with each other in the proper manner. The two sets *a b* and *c d* are free from confusion, and in the first set the end *k* of coil *a* can be seen connected with end *l* of coil *b*. In the other two sets the dotted and the dash lines are added, so as to show how the ring-winding can be transformed into the drum type. The object of both windings is to connect all the wire on the armature in series so that when the current enters through one brush it may divide and the two branch currents circulate around the armature, each one through one half of the wire, and come out at the other brush. The path by which the currents get through the wire is self-evident in the case of a ring armature, but it is not so with the drum type. Now conceive for a minute that the ring is solid and that there is no place for that portion of the coil that passes through the inside of the ring to be placed, unless it is at the opposite side of the ring. Suppose then that we stretch out the ring so that it will pass over to the opposite side, as is shown by the dash lines that prolong coil *e* to the other side of the circle. These dash lines are marked 1, 2, and the portion of the coil that, in the case of the ring, would be on the inside surface, fills the space marked 3, between coils *h* and *g*. The first thought that would come to us would be, that if this extended coil really takes the place of the coil *e* there must be no ends at 3, and this would be correct. The portion 3 of the coil is what we might call the back, and it may be located between the fronts of the two coils *g* and *h* or under coil *g*, the actual position depending upon whether the armature is wound with the coils in a single layer or in two layers. Coil *h*, being extended in the same manner as was coil *e*, will fill the space 12. In the same way the extension of coil *f* will occupy space 6, and that of coil *g* the space 9. From this it will be seen that the only difference between the ring winding and the drum winding is that in the former the back of the coil passes along the inside surface of the ring, but in the drum, as there is no open central space, the back of the coil must necessarily pass over to the other side of the drum and take a position between or under the coils, that in the ring armature would be regarded as being on the opposite side of the diameter. We can also see that if the coils are only one layer deep, every alternate coil will be without ends, since it is only the back of a coil whose ends are on the opposite side of the drum, and if the coils are wound two layers deep only those on the outside layer will have ends, since those forming the inside layer are only the backs of those on the outside layers.

It might occur to some that possibly the locating of one-half of the coil on one side of the drum, and the other half on the opposite side, would lead to an interference in the electrical action, and that one part of the coil would have currents induced in it that would be in a direction contrary to those in the other half; but if it is remembered that each half of the coil is under the influence of a separate magnet pole, and that the two are of opposite polarity, it will be seen that if one induces a current in a direction toward the commutator end, the other will induce a current in the opposite direction, and hence the induction on both sides will be in the same direction through the wire.

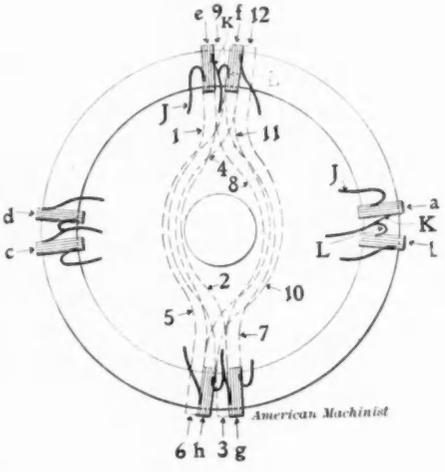

Fig. 1

SHOWING SIMILARITY OF PRINCIPLE BETWEEN DRUM AND RING ARMATURES.

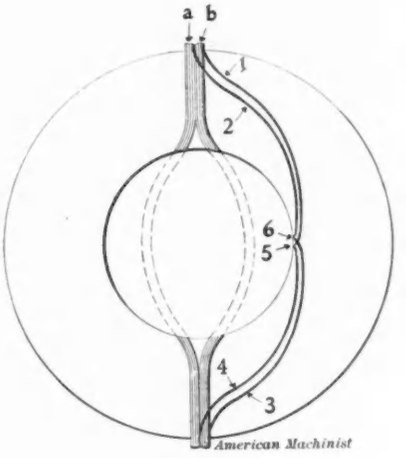

Fig. 2

SHOWING CONNECTIONS OF DRUM ARMATURE WITH BRUSHES OPPOSITE POLES.

The foregoing is the common form of drum-winding, but in some cases it is modified so that the two ends of the coil do not come out on the same side of the armature. This modification is shown in Fig. 2. It is only used in machines in which the brushes are placed on a line with the poles, instead of the space between them. The Edison machines are the best examples of this type. In this machine, as the poles are on the sides of the armature, the brushes would be located on top and bottom if the connections of the coil terminals were with the segments directly opposite them, but as the brushes are shifted around to the sides of the commutator, the coils have to be connected with segments that are one-quarter of the circle ahead, or back of them. This could be accomplished by making the ends long enough to reach that distance and carrying them side by side to the point of juncture with the commutator; but, as will be seen from Fig. 2, a length of wire equal to the distance across the end of the armature can be saved by taking one end from the front side of the coil and the other from the back. Thus, to connect the inside end of coil *a* and the outside end of coil *b* with segment 6, a length of wire equal to the distance from one side of the circle to the other could be saved by running the outside end of *b*, which is marked 3, direct from the back of the coil to the segment 6, instead of passing it over to the upper side of the figure and then returning it to segment 6. It can therefore be seen that although in this case one end of the coil comes from the front and the other from the back, it is only done to save wire, and the principles of winding and connecting remain the same.

This style of connection appears very complicated when the wires leading from the coils to the commutator segments are examined, as they form two layers, each one with the wires running in the opposite direction. By remembering that the only difference between this and the standard winding is, that the connection with the commutator is shifted around the circle, the complication will disappear When loose wires are to be replaced, or when a new commutator is to be connected with the armature, it is not as easy to find the proper ends as with the standard drum-winding; but if the ouside ends, as 3, 4 of coils *a b*, are tested with the ends coming from the opposite side of the armature, the inside ends of the coils can be readily found, and then all that is necessary is to remember that the inside end of coil *a* must be connected with the same segment as the outside end of coil *b*, the same order being followed all the way around the armature.

The drum-winding explained in the

foregoing is seldom found on any but two-pole machines; in the multipolar types it is extensively used, but in a modified form, this modification consisting in winding the coils on forms which give them such a shape that they can be placed in position upon the armature without interference with each other. This style of winding is shown in Fig. 3, in which a portion of an eight-pole armature is shown. The coils 1, 2, 3 are represented as some distance apart, so as to make the diagram clearer; in the actual machine they are closer together, unless the armature is of the grooved type. These coils can be connected with the commutator either in series or in parallel, just the same as the ring-winding explained in previous articles. To connect them in parallel it is evident that each coil must be joined with the adjacent one, as shown by the connections from the lower end of the coils to the center sections of the commutator. To be connected in series they must connect with coils one-quarter of the circle ahead, and as the two sides of the coil are an eighth of a circle apart, if the end on the left side of the coil is connected with a segment one-sixteenth of a circle back of it, and the end on the right side the same distance ahead, the two segments to which the ends of the coil are connected will be just one-quarter of a circle apart. This is clearly shown by the side connections with the commutator in the figure.

In the parallel connection the ends may run down to the commutator at the center of the coil as shown, or from the right or left-hand side, the position from which they run being dependent upon the position of the brushes, the center connection placing the brushes opposite the poles. The connections of armatures with separable coils are generally so easy to trace that no difficulty should be found in making proper connections without further elucidation of the subject.

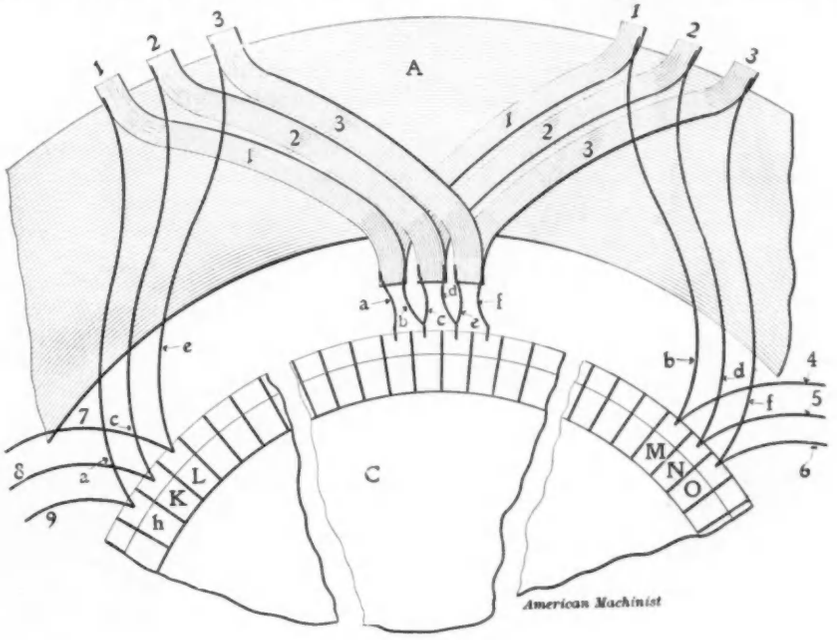

Fig. 3

ILLUSTRATING CONNECTIONS IN SERIES AND PARALLEL FOR MULTIPOLAR ARMATURE WITH SEPARABLE COILS.

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A Frightened Engineer.

I had never realized what an instrument of precision an ordinary glass gage had to be until I read the following editorial comment in an engineering paper that I took when I was steamboating: "The water in a gage glass is in effect a piston, whose areas equal the steam and water openings. If one of these last is inferior to the other, one end of the piston will have more pressure on it than the other, and the water in the glass will not show the water level in the boiler."

Says I, "I'll bet mine ain't the same within the sixteenth of an inch. I wonder how much difference that would make anyhow?" If the top one is five-eighths of an inch in diameter, the area would be .3068, and if the bottom one is eleven-sixteenths (one sixteenth bigger) its area is .3712 of a square inch, and the difference would be .3712 — .3068 = .0644 of a square inch. As I carry 100 pounds to the square inch, the pressure on this area would be 6.44 pounds, and as one pound will support a column of water 27.71 inches high, then, under these conditions, my water line in the glass would be 27.71 × 6.44, or over 178 inches too high. My hair stood right up, and I sang out, "Jack, try those gage-cocks, quick! If that editor is right, and my figures don't lie, our water level is somewhere down in the sewer." The gage-cocks showed two gages all right, and I made up my mind there could be no such difference in area. So I figured it over, assuming that the water opening was one-hundreth of an inch greater than the steam opening, and found that in that case the water would be over 27 inches too high. I shuddered when I thought how carelessly I had handled that gage when I had it down—actually scraped out the connections with the end of a file. If I had happened to take one more scrape on the lower than I did on the upper hole, I might have changed the indication of that gage 2 inches. I would like to know, Mr. Editor, if some of these boiler explosions, where there is "plenty of water," may not be accounted for by the area of the water connection being changed by a slight coating of scale; also, if there could not be a great saving effected in city waterworks by doing away with the pumps, sticking the end of the main right into the pond, and allowing the water to be forced into it by the difference in area of the pipe and the surface of the pond.—"Marine Engineers' Directory," San Francisco.

▲ ▲ ▲

Special Tool Steel.

At the Waverly Works, Sheffield, England, tool steel is now made of the section shown herewith, and is found convenient for many lathe and planer tools without forging. The end of the tool is shaped by grinding and, after tempering, is ready for use. The section of the bar consists of two equilateral triangles, point to point,

Fig. 1

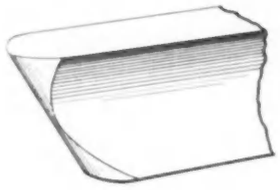


Fig. 2

Fig. 3

SPECIAL TOOL STEEL.

and strengthened at the junction. The same steel is also used for twist drills, being made by simply twisting, at, it is said, one-tenth of the cost of the standard twist drill. This twist drill practice is very extensive upon the European Continent. Our cut is from "Engineering," London.

▲ ▲ ▲

Stock booming does not appear to be confined to this country or to ventures in mines, if reports which reach us from England are to be believed. The English public is just now going crazy over bicycle manufacturing, over $100,000,000 having been paid for stock of new companies during the past year. The promoter is getting in his work on the usual basis of over-capitalization, and the result will doubtless be as usual.

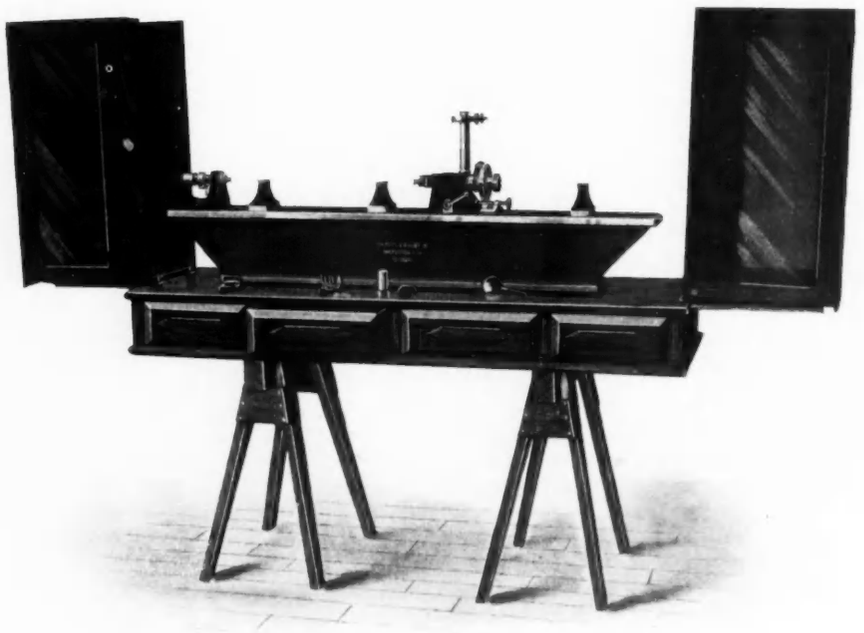
Protection for a Bench Measuring Machine.

The only real purpose of a good bench measuring machine is, to be used. It should be so located and arranged as to make its use convenient, and at the same time it is, of course, important to thoroughly protect it. We have pleasure in presenting herewith engravings showing how this may be done.

PROTECTION FOR A BENCH MEASURING MACHINE—CASE CLOSED.

In our peregrinations among machinery-building establishments, we see a good many fine and expensive bench measuring machines, and note a great variety of plans for caring for them. Some stand upon a bench and are covered by a cloth, which cloth must be removed and replaced every time the machine is used, and thus the dust which settles upon the cloth is shaken into the air, and settles with practical unanimity upon the machine. This plan is probably somewhat worse than having nothing whatever over the machine, and the last named practice is quite generally followed where the machine is in some special room.

At the works of the Warder, Bushnell & Glessner Company, at Springfield, O., General Manager Chas. A. Bauer has his Pratt & Whitney machine doubly protected by being placed in a special room devoted to similar apparatus, and also by the arrangement shown in the accompanying engravings. The cover, which is essentially a box of oak with glass sides and top, is in two parts, which, when closed, meet in the middle and form a tight joint. Each part is hinged to the table at the bottom, and either or both can be swung up out of the way, as shown, when the machine is to be used, and then rest upon strips of oak which are fitted to slide in and out at each end of the table, which also is provided with drawers suitably fitted for the reception of extras, standards, or other belongings of the machine. By keeping the outside of this case thoroughly clear of dust, which can be readily done, little or no dust is deposited upon the machine when in use. The case looks well closed or open, and is altogether the best arrangement we have seen for the purpose.



PROTECTION FOR A BENCH MEASURING MACHINE—CASE OPEN.

Quick Return Hydraulic Valve.

In hydraulic presses, punches and shears a comparatively small operating valve and connecting pipe suffice to give the requisite velocity of movement for the advance of the ram, but these orifices are entirely inadequate to allow a free return movement, except at the expense of a powerful and disproportionate pull back. The reasons for this are not obvious at first sight, but will be clear from a little examination. During the forward movement, up to the point where actual cutting begins, almost all the pressure of the water is available to force it through the passages of the main ram, as there is practically no resistance to the movement except that of forcing the water out of the small pull-back ram, the result being a satisfactory velocity of movement. On the return stroke, however, the water in the main cylinder must be expelled, and water must also be supplied to the returning ram. In other words, if the same velocity is to be obtained, the returning ram must have a surplus of power over the resistance of its own passages nearly equal to the entire power of the operating ram, which is equivalent to saying that the power and consumption of water on the return movement must be nearly double that of the forward movement. Even this is not the end of the story, however, as such a large returning ram adds to the labor of the main ram, since the water must be expelled from the returning ram cylinder by the main ram. In other words, the attempt to increase the speed of the return by this means, involves a corresponding decrease in the speed of the

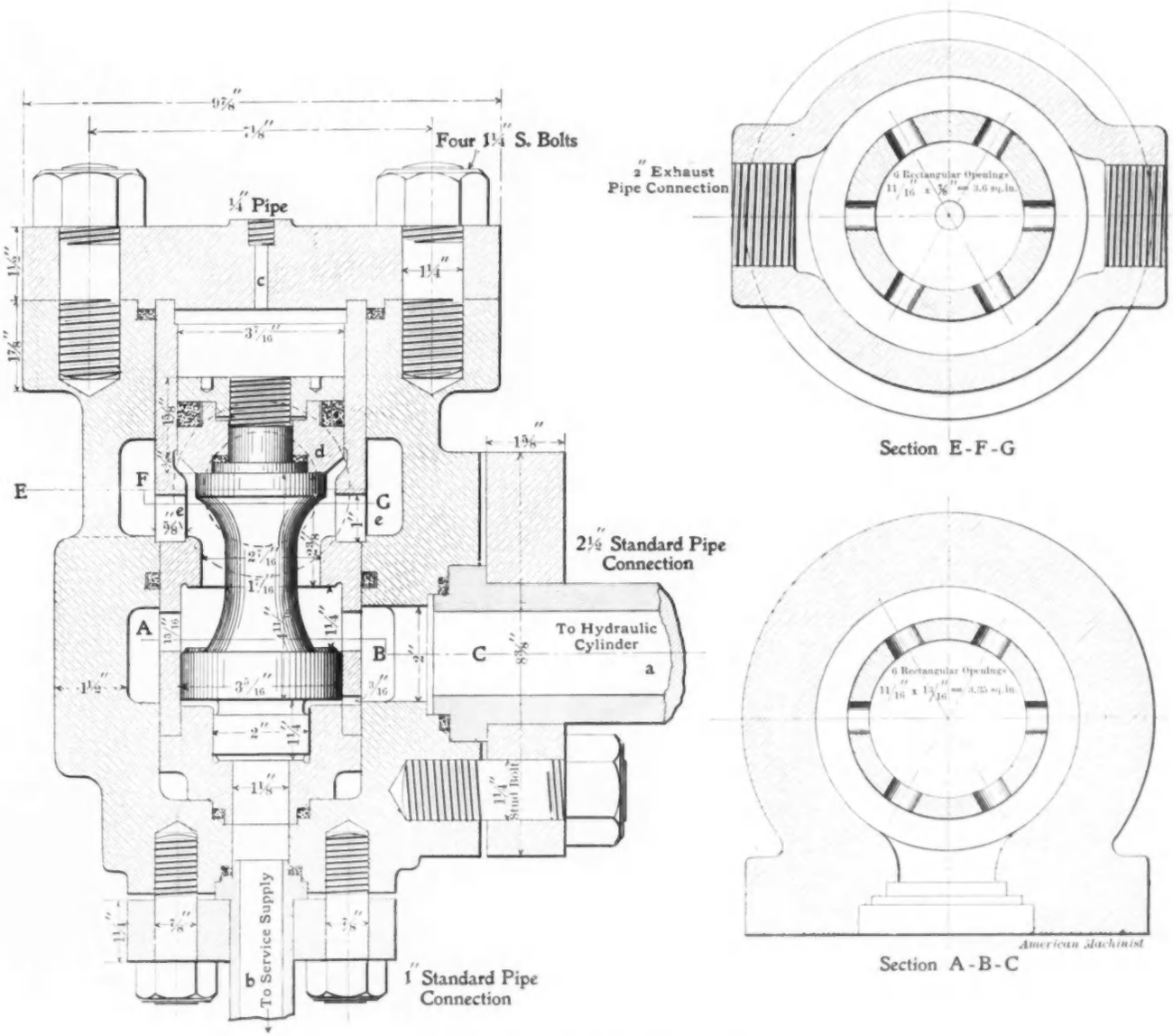
operating stroke, so that the increased consumption of water on the return stroke will accomplish nothing in the end. This see-saw will continue with any enlargement of the rams, any increase in the size of the returning ram slowing down the acting stroke, and if this is met by a larger main ram, a still larger returning ram is required, which again reacts to require a still larger main ram, and this action will continue to the end of the chapter. Consequently, in such work, a small returning ram is ordinarily provided, and a slow return speed is put up with.

Through the courtesy of the engineer of one of our large steel works, we are enabled to present, from a working drawing, an engraving of a valve which has been applied by him with a view of giving a larger discharge opening to the main ram, thereby securing a quicker return with a small return ram. The arrangement will be seen to involve a main valve operated by the water pressure, which latter is controlled by the usual small hand-operated valve, which becomes, with this arrangement, a supplementary valve.

The valve is attached at any convenient point, preferably directly to the hydraulic cylinder at *a*. The high-pressure fluid enters from below at *b*. At the top, at orifice *c*, is a connection to a small hand valve, which controls the action of the piston *d*, which forms the head of and actuates the main valve. The fluid is discharged from the main cylinder through the valve and the opening *e*, the valve, as shown, being in position for discharging the main cylinder.

In operation, when the fluid above the piston *d* is discharged by a small hand valve, the fluid at *b* forces the valve up at once, closing the exhaust and introducing the high-pressure fluid into the main cylinder. A reverse operation forces the piston *d* down, shutting off the fluid from the main cylinder, and simultaneously opening the exhaust *via* the outlet *e*. It will be observed that the valve is metal-seated, no live packing being necessary except that shown in the small piston *d*.

This valve is used successfully with pressures as high as 4,000 pounds per square inch, and operates as intended, providing a rapid return of the main ram.



QUICK RETURN HYDRAULIC VALVE.

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"Experts say that in its deepest parts the ocean's waters are so dense that a sunken ironclad would never reach the bottom." The "experts" must be expert in misstatement. It is strange that such items can keep in circulation, as does the above. It is well known that the sounding lead reaches the ocean bottom anywhere, which alone should be sufficient evidence in contradiction.

A Planer Tool Holder for Cutting During Both Strokes.

There seems to be a fresh breaking out, not violent, in devices for enabling the planer to cut during both strokes. There are some symptoms of it in our English exchanges. We illustrate an ingenious device for this purpose recently patented by Jos. A. Costello, Cleveland, O.

In this device a single tool with cutting faces on both the back and the front edges, is used for both cuts. The normal position of the tool is vertical, from which position it swings backward for the forward cut, that is, the usual cut of the planer, and it swings forward for the backward cut. The center of motion in swinging in either direction is near the center of the tool shank at *a*. The actual swing

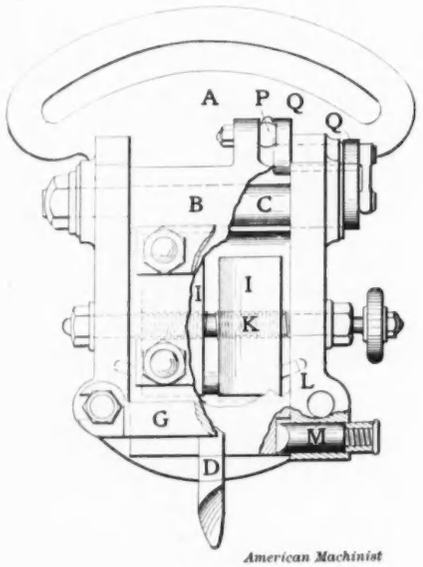


Fig. 1

PLANER TOOL HOLDER, CUTTING BOTH WAYS.

of the tool is accomplished by the sliding of the tool carrier or apron *B* upon the curved surface *c c*, whose radius is *a c*. When the tool swings forward it is stopped by the cross yoke *G* attached to the apron frame *A*, or rather by the adjustable wedge *H* inside of *G*. When the tool, or the apron *B*, which carries it, swings backward, it is stopped by the two wedge faced blocks *I I*. As these blocks *I I* are adjustable by means of the right and left screw *K*, and as the wedge *H* is also adjustable, the swinging of the apron in either direction may be controlled within the necessary limits. The tool may also be given a certain inclination backward or forward in the apron by tightening either the upper or the lower binding straps, causing the block *X* to slide a little downward or a little upward upon its circular bearing. The circular bolt *M*, with the double beveled end and the spring *O*, holds the apron and tool in their central position when neither edge of the tool is cutting. The weight of apron *B* is carried upon the eccentric shaft *C*, and the right angle lever *Q* and connection *P* attached to the lug above, give a movement which

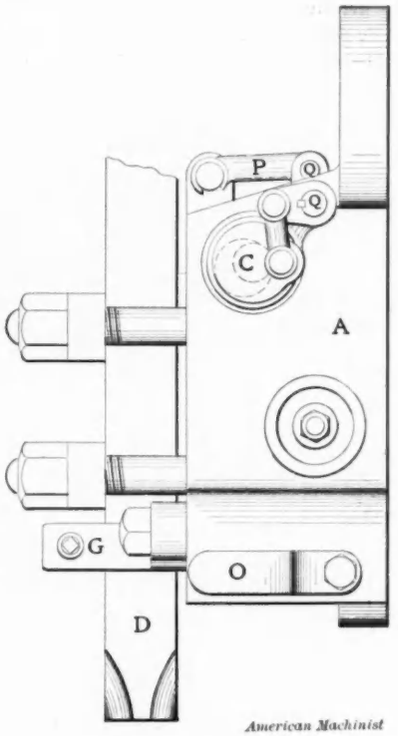


Fig. 2

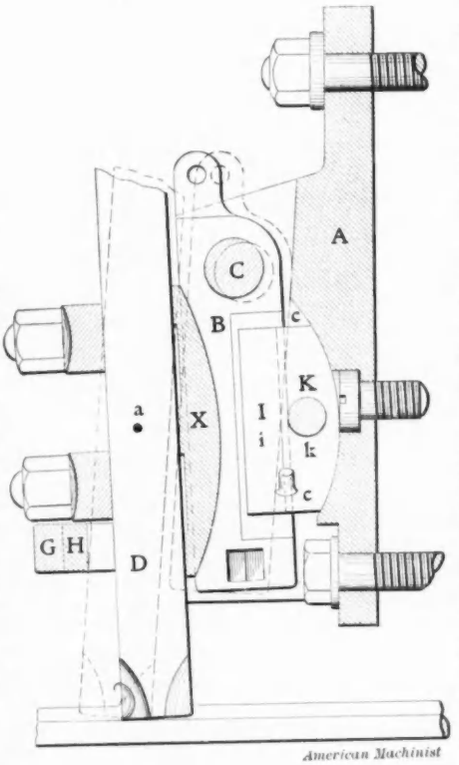


Fig. 3

retains the back of the apron in contact with the circular seat *c c*. Supposing the tool to be feeding in the direction of the arrow, Fig. 1, it is evident that if the side of the tool were a vertical plane, there would be no clearance, whether the tool were cutting in the one direction or the other, but with the cutting side inclined as shown, the tipping of the tool forward or backward, always gives the clearance required. The device seems to require a feed for each end of the stroke,

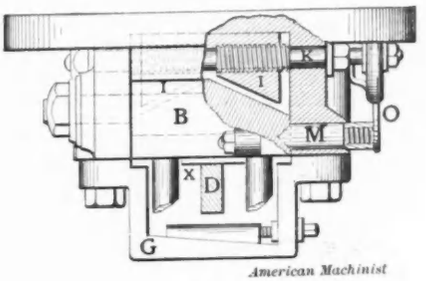


Fig. 4

the tool tipping down either way for the next cut by contact with the work. The device can be used for vertical facing or for most of the varieties of work coming to the ordinary planer.

The head can be converted to a single acting holder by disengaging the connection *P*, drawing wedges *I I* tight together and removing stop *G*.

▲ ▲ ▲

Letters from Practical Men.

Making Room for Chips—Hardening Tools.

Editor American Machinist:

I was reading Tecumseh Swift's article in your issue of February 4th, entitled "The Making of Chips," and agree with him that enough attention is not paid, either to the making of chips, or the disposing of them after they are made.

I was placed in charge of work in a machine shop a few years ago. Among other machines I had given me were twenty-three milling machines, some of which were taking deep, long cuts in forgings of machinery steel. The cutters were formed to the shapes required, and were cut very fine; the 3-inch mills having thirty-eight teeth and the 4-inch fifty teeth. It was impossible to machine more than thirty pieces on some of the machines in ten hours, and we were obliged to run a stream of oil on the cutter to wash the chips from the teeth, so that we could do even that number. As soon as I could get to it, I had some cutters made the proper shape, cut nine teeth in them, backed them off on a fixture made for that purpose, hardened them, put them on the arbor, and turned off from the first set of cutters the first day 185 pieces. Why the difference? The cutters with the fine teeth had no room between teeth to hold the chips, and being so close together, chips had a great tendency to not only lodge there but to stay there, and then there was no room for the next chip, and so the cutter became clogged and the teeth had

to break, while with the coarse teeth there was plenty of room for the chip and not much tendency to hold it, so the cutter was free to take as heavy a chip as was consistent with the strength of the machine and fixtures holding the work.

The same principles apply to almost any cutting tool, especially those doing internal work, as reamers, counterbores, taps, etc. How often we see a tap used for tapping nuts that tears the thread, we look at it very closely, the cutting edges look all right, the backing off appears to have been done properly, we tap a piece of stock, letting the end of the tap barely come through, and saw the piece in two without removing the tap, we find the flutes packed full of chips and tearing the thread. We make another, cut the flutes deeper, backing it off the same as the first and we are able to cut a nice clean thread.

Nineteen years' practical machine-shop experience, thirteen of which I have been in charge of work, designing and making tools, and using them when they were made, has led me to believe that a very essential thing in designing certain cutting tools is to provide a way and place for the stock you remove in the form of chips.

I see a great many articles in your valuable paper, on hardening and tempering steel. Some of these articles are very valuable for young men just learning the trade to read; some of them must be—well, not so good for them.

I have been so circumstanced for the past fourteen years that I have done most of my own hardening and tempering, or have had it done under my supervision. I do not have much trouble with tools cracking or crooking in fire or cooling baths, and I use the so-called high grades of tool steel. Many of my milling cutters for power millers are backed off mills, one part of which will be 3½ or 4 inches in diameter and another part of same mill not over 1¾ inches and a 1-inch hole through them, with a spline cut ⅛ deep. I never think of losing a tooth or even cracking one, but I *do not* heat them in an open fire and quench in a cold water bath.

I have some long broaches 12 to 16 inches long to temper. I put these into a kettle of red-hot lead, placing a piece of cyanide on top of the lead. When my piece is heated through, draw my broach slowly up through the cyanide; when it is melted, lower it down into the lead again; let it stay a moment; then plunge into a hot water bath until the red has disappeared; plunge it into oil and let it cool off there. I never have any trouble with the piece springing. I temper fluted reamers and similar tools this same way, only I allow them to stay in the water a trifle longer than I do the broaches. Speaking about broaches, though, it is very essential to have room between teeth for chips, and have them so shaped that there will be no tendency for the chip to draw back onto the next tooth, as it will be sure to tear.

MECHANIC.

▲ ▲ ▲

Shade Lines on Drawings.

Editor American Machinist:

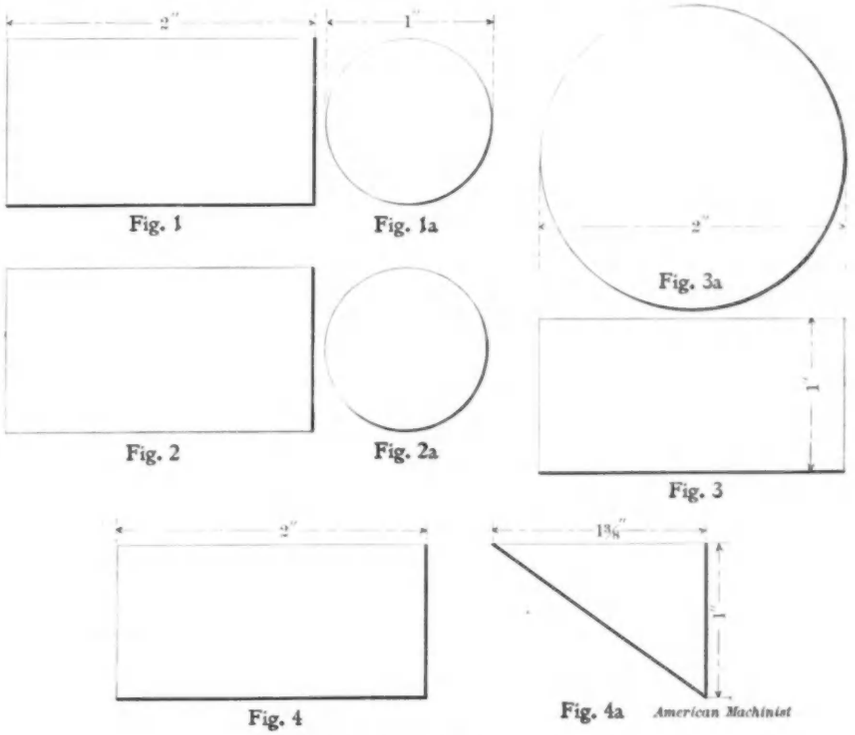
I was very much interested in the article, by Mr. F. A. Halsey, on line shading, rules and conventionalities, but would like to take exception to his method of shading a cylinder. I am aware that it is a practice with a great many draftsmen to shade the lower line in Fig. 1, as well as the one on the right-hand side. Is there any reason why this line should be shaded? Does it add to the clearness of the drawing? Or is it not shaded merely because lower and right-hand lines are usually shaded?

Fig. 1, as shaded above, would suggest itself to me as an elevation of a rectangular body, were it not for Fig. 1*a*; while I would at once recognize Fig. 2 as a cylinder 2 inches long and 1 inch in diameter, and Fig. 3 as a cylinder 2 inches in diameter and 1 inch long.

R. D. HAWKINS.

La Fayette, Ind.

[So far as light and shade are concerned, the lower edge of the piece shown in Figs. 4 and 4*a*, is situated like the lower boundary of Mr. Hawkins' cylinder, Figs. 2 and 2*a*, and if he makes one light he should make the other the same. How, then, would he distinguish between them? Obviously he cannot do it without reference to the end view, and the same is true of other shapes that might be drawn in place of Fig. 4*a*. In other words, his cylinder drawing does not distinguish the cylinder from many possible shapes. I believe that the only sensible view of this matter is to make the lower and right hand sides heavy, regardless of the section. The section cannot be shown by the heavy lines, and it is better to confine the use of the lines to those points which they can show, rather than try to make them distinguish what they are incapable of doing, and in doing that defeat the one thing which they can show and show well. In other words, it is better to accomplish one thing by their use, than it is to try to accomplish more and end by accomplishing nothing.—F. A. H.]



SHADE LINES ON DRAWINGS.

That Paper Washer.

Editor American Machinist:

Some months since, C. O. Griffin illustrated a plan for giving a taper pin draft by the use of a paper washer under the shoulder. The plan struck me so favorably that I determined to try it, should opportunity occur. Not that I had any use for it, but mainly from what might as well be called curiosity as anything else. The opportunity came, and I tried it as follows. Beyond question, the little trial had none of the elements of a test about it. I can only call it self-satisfactory:

I had at hand two square blocks of cast iron, *a* in the sketch. Through these I drilled and reamed 1-inch holes, afterwards squaring them up for the shoulder of rod or pin. To these I fitted one end of a piece of round iron, 1½ inches diameter, thus leaving a shoulder of only ¼ inch. The fit was just sufficiently tight to insure the shoulder against working away from its seat when the hole for pin

was being drilled and reamed. The pins fitted just about as such pins usually fit—neither particularly better nor worse—the whole intention being to make just an average good job, and no more. Between the shoulder and seat of one of these pieces the paper washer was placed and both pins were driven, a little hard at first, then driven back, and again driven "about right."

For the trial, one of the pieces was placed on a block of iron which happened to have a hole through it, convenient for the purpose, and struck a fairly smart blow with a chipping hammer, then reversed and similarly struck, this being repeated until each end of each rod had received a hundred blows. I am aware of the weakness of the expression, "fairly smart blow," but cannot help it very much. In the effort to do so, it may be said that they were in no sense shearing blows, but such as might be taken to represent rather uncommon hard usage from reversing the direction of motion, in practice.

At the conclusion of the little rough-and-ready experiment the pin in the piece with the inserted paper washer was as

THAT PAPER WASHER.

firmly and as correctly seated as ever. That in the piece without the washer was emphatically shaky, just as every machinist has seen such pins.

As intimated, this is not submitted as in any sense a "test" of the paper washer. For me the experiment, crude as it was, was sufficient. To the critical readers of the "American Machinist" it is submitted as "corroborative evidence" only. To my mind the very slight springy character of the paper is in its favor, but more than this is the fact that the pin, acting as a powerful key or wedge, forces the shoulder of the rod against its seat stronger than there is any effort to force it away, hence it stays there.

F. F. HEMENWAY.

Brooklyn, N. Y.

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The Niles Planer Tool—Portable Shop Lamps.

Editor American Machinist:

About two years ago I attempted to describe, in your columns, the Niles finishing tool for planers, but did not, I am sure, make its form and action so clear as has been done by Mr. Wm. Pilton in your issue of March 11th. I am also very sure that the value of this tool is not very generally known or appreciated; besides, its peculiar shape varies as much from everything else in the line of finishing tools that I dare say there is not one person in ten who attempts to make and use it that will succeed. However, when the proper form is secured and is properly set, it is sure to give satisfactory results. I think Mr. Pilton's statement that "It works well without the aid of a lubricant or cutting solution," requires some qualification. In order to secure a good finish, I have found suds or soda water necessary.

For those who may use this tool for the first time, it may be of importance to call attention to two or three conditions essential to success: First—It must be hard enough to hold a perfect edge. Second—The edge should be ground perfectly straight and with usual clearance, the corners being slightly rounded. In honing the tool by hand, the edge will be slightly rounded, which may be hardly perceptible, but enough to meet the requirements. Third—The vertical edge should be very slightly inclined away from the cut, if toward the cut chattering is very sure to result. When placed in position the contact with the work may vary a quarter of an inch either way from the center of the tool, preferably that much to the rear; by this a fresh cutting edge may be had by thin shims being placed under the end of the tool, thus avoiding regrinding.

The phenomenal performance of this tool warrants, I think, an effort to make its value known; besides, cutting tools in general have been having a good deal of attention of late; but whether the two or three million shapes may be formulated or not, is another question, and one which may not greatly interest the practical machinist.

LAMPS.

Although the importance of good light in the machine shop is now thoroughly understood, yet it frequently occurs, from one cause or another, that hand lamps are necessary; these are found in the market of various shapes and kinds, but are seldom equal to the hard knocks which they get about a shop, rolling mill or roundhouse.

Herewith are sketches of home-made lamps, or torches, which I have made and used, and found them to meet the requirements. Fig. 1 is the simplest in form. The case *A* may be of brass tubing or 3-inch gas pipe turned down to proper thickness. Brass or iron top and bottom are screwed or soldered to the case. The

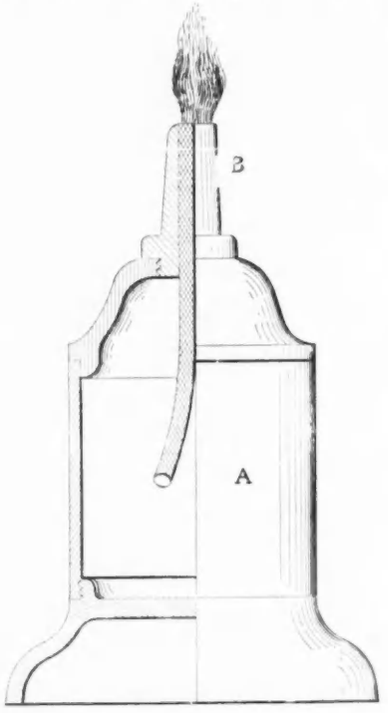


Fig. 1

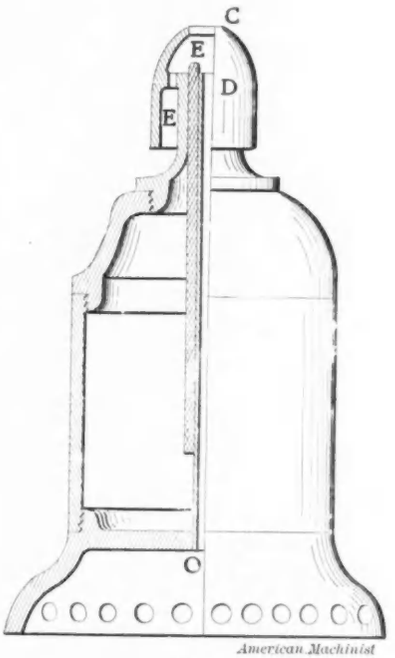


Fig. 2

PORTABLE SHOP LAMPS.

tube *B* is suited to a ½-inch wick. The light produced is somewhat red and smokey, but this may be tolerated where all the surroundings are grimy.

The lamp shown by Fig. 2 emits a brighter light, and is free from smoke when the wick is properly adjusted. A central tube of ½-inch pipe is here provided which attaches to the bottom at *a*; this supplies a current of air to the surrounding wick at *c*. Another current passes up through the hood *a*, at *l*. When lighted, an amount of unconsumed gas forms in the chamber *e*, and on reaching the air at *c*, ignites and produces a bright light with next to perfect combustion. The redeeming feature in either of these lamps lies chiefly in their being indestructible, as compared with other kinds in use.

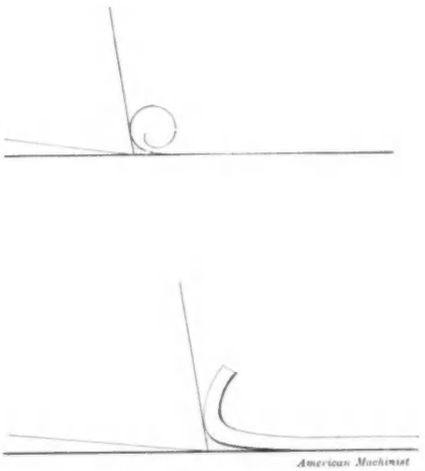
QUIRK.

Rolling the Chips—Helical Chips from Lathe and Planer.

Editor American Machinist:

It was a misfortune, at least triple-acting, that the sketches referred to in my note in your issue of February 18th did not appear with it. There was first the loss of my labor in the preparation of the drawings, then there was, of course, a loss of readers for the article, because there are so many like myself who are more apt to read a piece with "picters" than one without, and then, to those who did read it, there was perhaps more or less of a loss of what meaning there might have been in it, and, besides all that, there was a loss of the cuts themselves; but I may suppose that they still exist, and that the editor will kindly make an effort to have them appear with this, and so make me happy again.

The sketches referred to were intended to suggest why it takes more power to



Figs. 1 and 2. ROLLING THIN AND THICK CHIPS.

cut off a thick chip than a thin one. They show that when the thick chip is being severed, as it does not bend as easily as the thin one, there are actually more fibres being torn apart at the same time than when a thin chip is being severed, and of course more power is required to tear those fibres and separate the chip from the solid body of metal. That was all that I said before, and all that the sketches were intended to show; but, being so elaborate, Figs. 1 and 2, they are capable of assuming a more extensive responsibility. They show also that, after the chip is actually severed, it takes more power to keep rolling the chip out of the way. If we take a heavy chip in our hands, we find that it takes considerable power to bend or roll it; but the rolling that occurs when the cutting is going on must require very much more pressure on account of the minute shortness of the leverage where the point of the tool operates. The sketch also suggests pretty clearly why chips are always shorter than the length of the cut or the travel of the tool in making them. It is because the chips are bent or curled by external pressure and are compressed longitudinally in the operation of bending.

Another of those adverse coincidences that seem to happen occasionally in the career of Mr. Tecumseh Swift has just come to the notice of the readers of the "American Machinist." In the issue of February 11th he told us the whys and wherefores of the fact that the planer tool makes spiral chips and the lathe tool makes helical chips, and then Mr. Pilton, March 11th, comes along and shows us a planer tool making helical chips. I am inclined to think, however, that Mr. Swift is more than half right this time.

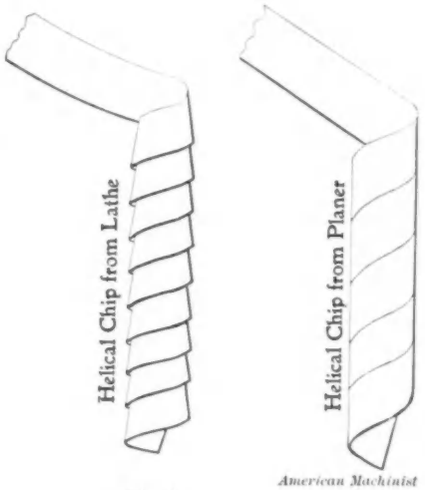


Fig. 4 Fig. 3

We can take a straight strip of paper and wind it around a lead pencil, Fig. 3, giving it a pitch equal to the width of the strip, or more than that if we don't want the edges to touch, and the paper will lie perfectly slick and smooth, and it would be quite possible for a planer tool with the cutting face at a steep angle to the line of motion to roll a chip in that way. If, however, we try to wind the strip with less pitch, or so that the strip will lap, say, half-way over the preceding coil, we find that it will not lie so slick. The thicker the strip the worse it will be. Try it with a belt lace. This will not be a perfectly fair trial because the belt lace is so soft and yielding, but it will show the idea. If we take and cut a circular strip instead of a straight one, we will find, if the radius is anywhere near right, that it can be rolled very well on the plan of Fig. 4, and that is the way the lathe chip is rolled. The ends that I have left sticking out at the upper ends are, of course, not yet severed from the metal, as the tool rolls the chip as fast as it is split off; but the ends suggest the shape in which the material comes to the rolling. The curved strip in No. 4 should have more of a curve to it, or be made with a shorter radius to it than my sketch shows.

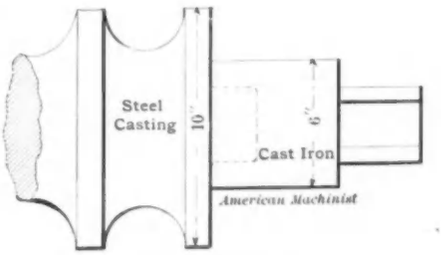
MORRIS FULTON.

Philadelphia.

A Case of Fusion—Good Wear of Cast Iron.

Editor American Machinist:

In order to secure greater strength, it has been found advantageous to make the smaller sizes of rolls of cast steel, although the "necks" or journals do not wear nearly as well as cast iron does. To save an otherwise good steel roll, we



A CASE OF FUSION.

treated it the same as an iron roll, viz., "burnt" a new neck onto it. The dotted line in the enclosed sketch shows about where the two metals united. The roll has been in use for several months, and has held its own with the rest of them.

J. H. DUNBAR.

Youngstown, O.

▲ ▲ ▲

Those English Keys.

Editor American Machinist:

In your issue of March 4th you have two sets of keys. We would say that the key represented by Fig. 2 has been in use in our works for at least twenty years. We have found it to hold where other keys have failed. For holding pulleys and engine cranks on the shaft of direct attachment saw mills, the crank being on the same shaft with the saw, we found it to be the only key that would give satisfaction.

HART BROTHERS MACHINE CO.,
Per J. B. Hart, President.

Clarksburg, W. Va.

▲ ▲ ▲

Inventor of That Substitute for Bevel Gearing.

Editor American Machinist:

In regard to Mr. Birkett's letter on this subject in your issue of February 25th, the device for angular drive, illustrated in the "American Machinist" of November 12, 1896, was made by Ellis & Co., of London, Eng., then makers of the "Facile" bicycle, in about 1885, to the order of an officer whose name I do not remember to have heard. Curiously enough, the same device was exhibited at the Salon du Cycle at Paris, last December, as the new invention of M. Michaux, one of the very earliest of French cycle makers.

J. H BALL.

Beeston, Notts, Eng.

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The Little Shop.

The law of shop life seems to be to grow or die. Believing in this law quite implicitly, we have to confess to a constant and active interest in, and an abiding affection for, the little shop. We may run over in our minds a list of the largest and most prosperous shops of to-day, and it is difficult, if not impossible, to find one that is not the product of a growth, more or less steady, from very small beginnings. In every little shop of to-day may be the possibility—there may or may not be the promise—of unlimited growth and development. Many a shop that is of little account to-day is doubtless the germ of some great establishment of the future.

The outlook, however, for the young little shop is very different from that of the old little shop. While hopes may cluster luxuriantly around the former, they twine but sparsely around the latter. We all expect the young shop to grow. There is some surprise expressed when the old shop starts out to grow again, and we are apt to ascribe the development to an infusion of new blood or of new life, which is almost invariably found to be the case.

It is not as easy for, say, an ambitious young machinist to establish a business as it is for a shoemaker. Ten dollars will equip a shoemaker with tools and supplies better than a thousand dollars will do for a machinist. This is not all, nor indeed much of it, a disadvantage. The business so easy to get into is quickly filled, is always full, and the holdings of each individual range small. The ten-dollar business, to begin with, soon gets its growth, while the one with broader roots keeps spreading its branches wider and lifting them higher.

The starting of the little shops that are eventually to grow into the big shops is undoubtedly going on to-day as heretofore. There may be changes in the modes and details of development, but life and hope are still operative and still prolific.

There are some phases of shop life and growth that are deserving of study. A shop business consists not alone in doing the work. It consists very largely also in finding the work to do, or in profitably disposing of the work done. Customers are not numerous, nor easily found, and ingenuity and perseverance in their pursuit can never be dispensed with. A sign hung in the window may be sufficient to keep the shoemaker pegging away all the day long; a sign hung in the machine shop window would merely keep out so much sunlight and rarely bring anything in.

In some respects the little shop of to-day has fewer difficulties to encounter in getting established, and certainly more of the essential means of its life and growth are provided than in the olden time. Just as man has better food and in greater variety than ever before, so the little shop finds infinitely less trouble in getting ready tools and all manner of supplies and material. No machine business must in these days have a foundry as a necessity, and the little shop is better without it. Nor must it waste its time in making small tools or small parts of machines, which have now become standard supplies, and which it can buy cheaper than it can make them, if it is in a position to realize a profit on any of its work.

The little shop has at the beginning the one great advantage of a very small proportion of "unproductive" labor. It may, indeed, have absolutely none. The proprietor may be all hands. Then he may get a boy, then another man or two, and still all be "productive." His safe may be in his hat. His bookkeeping may be his evening amusement, and perhaps his drafting, too. His bill-collecting may perhaps give him some of his first experience of the unproductive. While the methods and facilities of the little shop will not generally be in all respects comparable with those of the large and fully equipped establishment, the accompaniment of perhaps fifty per cent. of unproductive labor may more than counterbalance the advantage.

No machine business seems to be built upon eternal foundations. While there is a law of growth, there seems to be also a law of decay. While we fully believe in the former, we believe in the little shop as the germ that has in it the possibilities of growth and full development and fruition as completely in these days as ever before.

▲ ▲ ▲

Shop Prisons.

We occasionally receive letters similar to the one which we make some extracts from below. It is from a machinist, and he says: "I am a believer in order and system, etc., but think sometimes these things go too far. I am acquainted with a shop where Mr. X. is foreman, and where the men are treated precisely as though they were machines, or, at most, dumb brutes. The shop has very poor ventilation, is poorly heated, and uncomfortable generally, and even the tool-makers are driven by a foreman who watches them as a slave-driver used to watch a lot of negroes. The men in this tool-room are supposed to be a lot of mutes, and cannot speak a word in working hours. If by chance a workman asks his bench-mate something about the work or tools, or how long before he can use a certain machine for his work, Mr. X. will call the man down with the air of a king, saying that he 'will not have talking in working hours.' Perhaps this is the proper way to treat skilled and intelligent machinists and tool-makers; but it looks, from my point of view, more like prison life than the life of a free American citizen."

We aim to confine ourselves mainly, if not entirely, to the purely technical side of the machinery business, but this is a matter in which our readers and friends, whether they be employers or employés, are vitally interested, and we have not the least doubt that those shops in which such practices are allowed are greatly the losers thereby. Our correspondent says he does not think this is the way to treat skilled and intelligent machinists. We go further and say that this is not the way that skilled and intelligent machinists are treated, save in exceptional cases. That is to say, wherever a skilled and self-respecting machinist finds himself in a shop where such absurd rules as these are attempted to be enforced, he simply gets out of that shop at the first opportunity, and if he is really skilled and intelligent, he probably does not have to wait very long for the opportunity. The result of this is that such shops are, in the main, able to retain the services only of the inferior class of men, and this is just as it should be. The man who undertakes to run a shop in this way simply shuts his eyes to the facts of human

nature, and injures himself and the shop by which he is employed far more than he does the men. There is no theory about this; the experience of the best conducted and most successful shops in the country clearly shows that such conduct upon the part of a foreman is not only an outrage on the men, but is economically the worst course possible to be followed.

We unhesitatingly advise every mechanic who finds himself in such a shop to seek diligently for another situation. There are plenty of shops in which men receive decent treatment, and all the decent men should be employed in them, to the advantage of both men and shops.

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Mr. Fred. J. Miller, Editor-in-Chief of the "American Machinist," sailed on the steamer "New York" of the American Line on March 31st. Mr. Miller expects to be away for at least three months, and his time will be entirely devoted to the visiting of European manufacturing establishments and the gathering of information upon every topic in which the readers of the "American Machinist" are interested. The results of his labors will be duly presented to our readers. The best wishes of his associates and of all who know him will follow him throughout his wide travels.

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We have received from the Police Department of Amsterdam a "revised list of merchants upon which the Amsterdam police office calls particular attention of the trade." The list is very formidable and covers over 150 names. It would certainly be well for all American exporters dealing with Amsterdam houses to obtain a copy of this list, which we presume can be had by addressing the Chief of Police at Amsterdam. The list will be kept on file in this office and may be consulted by anyone desiring to do so.

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The President of the United States has appointed Benjamin Butterworth, of Ohio, to be Commissioner of Patents. General Butterworth was appointed to the same office in 1883, but held it then for only a short time. There is no apparent reason why he should not be as efficient and every way satisfactory in the administration of the Patent Office as Commissioner Seymour, so that the people have great reason to congraulate themselves over the change.

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Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer questions by mail.

(41) J. S., Middletown, N. Y., asks: What size air compressor would be required to maintain a constant supply of air at 60 pounds gage pressure to be discharged at that pressure through a hole 1-16 inch diameter? I would like to make the compressor on about the same principle as a steam cylinder, only receiving the air through the heads and discharging through check valves; speed about 70 revolutions per minute. A.—Probably about the right size for the compressor cylinder would be 4 inches diameter and 6-inch stroke. With air at 60 pounds pressure, a hole 1-16 inch diameter would discharge from 3½ to 4 cubic feet of free air per minute, varying with the style of orifice through which the air escaped, as well as the actual diameter. The theoretical capacity of the compressor cylinder of the size given above would be: $4^2 \times .7854 \times 12 \times 70 \div 1728 = 6.108$ cubic feet per minute. It is very certain that not all of this volume of air would be compressed and delivered, as some would remain in the clearance spaces and re-expand on the return stroke, instead of being expelled.

(42) B., Tiffin, O., asks: To recut a spiral mill, and not knowing the spiral lead, what is the easiest and simplest way of figuring to ascertain it? A.—The simplest way of doing this is to stand the cutter on a surface plate and then apply a bevel protractor to the edge of one of the teeth. This will give you the angle of the spiral or helix, and, knowing this angle, you can then usually find out the corresponding pitch or lead for the work of the given diameter from the table of spirals accompanying the milling machine. If, however, you have no such table, then the simplest way of obtaining the lead will be to lay off two lines joining each other at an angle corresponding to the angle determined as above. On the base line erect a perpendicular at such a point that its length will equal the circumference of the cutter. The length of the base line from the apex of the triangle thus formed to the perpendicular line will be the pitch of the spiral or helix.

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Commercial Review.

NEW YORK, SATURDAY EVENING, APRIL 3D.

DYNAMOS AND MOTORS.

With due allowance for hard times and a number of other things, the electrical machinery market is to be pronounced in a fair position. Reports from some of the most important electrical manufacturing interests are cheerful in tone. Street railway work is pronounced hopeful, and a fair amount of business has been already closed. The contract for the equipment of several Metropolitan lines in this city with the underground conduit system, which we have spoken of on previous occasions, but which may be considered as a part of the March business, since the negotiation was settled during that month, is said to be about the largest order of the kind placed in two or three years.

There are still favorable symptoms in the small motor trade. Minor manufacturers changing their quarters are here and there availing themselves of the opportunity to install electric power in place of steam, or whatever they may heretofore have been using. A notably beneficial feature of trade in electrical machinery, is the growth of its applications. One of the latest is found in a contract which the C & C Electric Company are now executing, namely, a motor to be used in lifting the portcullis of the Twenty-third Regiment armory, in Brooklyn, N. Y. There was a time when portcullises were much more common than electric motors, and now motors are more common than portcullises; but we do not recollect having ever before heard of the two being used in combination.

Among isolated lighting plant equipments for New York buildings, recently contracted for, is that for the St. James Hotel, involving two 75, two 50 and one 25-kilowatt Walker dynamos; also the Crocker-Wheeler outfit for the Standard Oil Company's building, alluded to last week. From across the East River, in Brooklyn, the Eddy people, who are represented locally by H. B. Coho & Co., have lately received orders for a 50-kilowatt generator for the Clarendon Hotel, and two 30-kilowatt machines for an industrial establishment.

It is encouraging to note that the Holzer-Cabot Electric Company are so crowded with work that they propose to add three stories to their factory. This does not mean that they have found the past month relatively a good one, in this quarter, at least; but it indicates either that a good deal of business in fan and other small motors, telephone material, etc., must have come in somehow not very long ago, or else that they feel justified in preparing for a season of active trade.

ELECTRIC RAILWAYS IN EUROPE

are still keeping up a good demand upon this country to furnish them with electrical machinery.

The March volume of United States Consular Reports contains several articles bearing upon this subject and upon European steam railroads. According to one of them, the number of electric railways in Europe rose in 1895 from 70 to 111, and their length from 435 to 460½ miles. Of the final total, 252 miles were in Germany, 82 miles in France, and 66½ miles in Great Britain and Ireland. The report states that German electrical companies and supply manufactories have greatly increased in number during the past few years, and "are constructing electric lines with steam engines down to the smallest isolator, thus giving an impetus to the boiler and car manufacturers." At the time of writing (December 3, 1896), Berlin was just about to introduce general electrical locomotion in its streets; Hamburg and Leipsic having their street railways nearly completed. The overhead trolley surface system, it is thought, owing to its cheapness, will continue to be preferred. Another Consul writes regarding some agitation to install electric roads in Catania.

All of which goes to show that, notwithstanding the Old World is rather backward in the adoption of electricity as a means of locomotion, it is beginning to make progress. This furnishes the counterpart of what has from time to time been reported in these columns regarding good sales of street railway machinery, which American companies are making for European account. We shall not be surprised

if the statistics of 1896, when available, show that the progress has been considerably greater than in 1895.

MISCELLANEOUS.

A traveling agent of a certain power hammer company remarked to us to-day that a recent business tour had convinced him that trade was slowly reviving. "It is like a recovery from typhoid fever," said he, "You don't expect to see one who has been in such a condition become as vigorous as Corbett or Fitzsimmons at the end of a single week; but it is all the time gradually gaining, nevertheless." The cities which he has visited and to which he referred in particular included Pittsburg, Chicago, St. Louis, Harrisburg and Millersburg.

A permanent exhibition of machinery is to be established at Lima, Peru, to be opened July 28, 1897. Important articles will be admitted free, under bond, if not to remain longer than six months.

Attention should be called to the fact that a Mr. Alfred Mosely is now preparing to develop some diamond property in South Africa and is a probable purchaser of some traction engines, having 7-foot driving wheels two feet wide, and each equipped with a drum to hold 1,200 feet of ¾-inch steel rope. Mr. Mosely is now in Kimberly, but we should infer from the facts given, makes his headquarters at Cape Town. The Alvino Mine, at Durango, Mexico, has been purchased by St. Louis parties, who propose to spend $400,000 in developing it, and will need mining machinery and supplies.

PITTSBURG REPORT FOR MARCH.

Conditions in the iron and steel trades are somewhat improved since the last report. Manufacturers of all kinds of goods have a more hopeful feeling regarding the future, and many are contemplating improvements of their plants in order to be able to meet the requirements of the coming increased business. In fact, at the

(Continued on page 35.)

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Business Specials.

Gear wheels, gear cutting. Grant; see page 16.

Forming Lathes. Mer. Mach. Tool Co., Meriden, Ct

Good gear cutter for sale cheap. B. V. Covert, Lockport, N. Y.

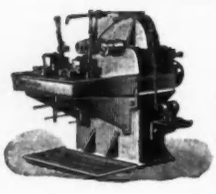
Engine Castings ⅛ to 2 H. P. Finished boilers and engines. Grant Sipp, Paterson, N. J.

Send $1 to the Tabor Mfg. Co., Elizabeth, N. J., for improved stop-motion revolution counter.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y.

FOR SALE—EQUIPMENT OF TOOLS for FINE work. Brown & Sharpe No. 2 Universal Miller, 3 Lathes, 2 Drill Presses, Shaper, Grinder, Drills, Reamers, etc. Nearly new. Address

"EQUIPMENT," American Machinist.



Automatic Solid Die Bolt

THREADING MACHINES.

Two Styles. Four Sizes.

Send for Catalogue "A."

Webster & Perks Tool Co.

Cor. Spring and Monroe Sts., Springfield, Ohio.

Wants.

Situations and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday Morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Situations Wanted.

Prac. dftm. seeks pos.; 12 yrs. exp. 160, AM. MACH.

Position, by all around prac. mech. draftsman; best refs.; moderate salary. Box 154, AM. MACH.

Expd. metal patn. mkr. wants pos.; competent to take charge; wages moderate. Box 159, AM. MACH.

Tool maker, also gig work, used to micrometer measurements, management of milling and grinding machines. Box 144, AMERICAN MACHINIST.

Mechanical draftsman having extensive exp. in designing marine, stationary high speed engs and dredging machy. wants pos. Box 143, AM. MACH.

Foundry foreman—Position wanted by a sober, reliable man; 10 yrs. exp. as foreman on gen. mchy. & light bench work; good refs. Box 155, AM. MACH.

Wanted—Position, supt. or foreman, by thorough prac. mech. and draftsman; engines, boilers and general machinery; modern economical practice. Address, Engine, 714 Parade Street, Erie, Pa.

A mechanical engineer, with highest refs., who is going to Europe, would like to act as representative for parties desiring to introduce new mechanical appliances. Box 156, AMER. MACH.

Mech. eng., 30, wide experience and education, mem. A S.M.E., owns valuable pats. on gas engs. for direct cpld. elec. serv., desires con. with subtl. concern needing eng. or supt. Box 161, AM. MACH.

Tech. graduate, familiar with construction and latest design of direct act. pumping mach., including comp. and triple, also machs. in general, desires to change pos.; chief draftsman or asst. supt.; age 32. Box 162, AMERICAN MACHINIST.

Wanted—Position by experienced engineer, tech. grad., specialist in design, construction and erection of machine tools and hydraulic mchy.; can superintend erection, take charge of design or drafting room. Box 153, AMERICAN MACHINIST.

Help Wanted.

Help Wanted—Good pay for leisure hours. Geo. W. Lord, Philadelphia, Pa.

Wanted—First-class tool maker, one used to die work. Apply, Ridgway Dynamo & Engine Co., Ridgway, Pa.

Wanted—Foreman brass moulder with thorough knowledge mod. fdy. requirements. Give experience, age and wages expected. Box 141, AM. MACH.

Wanted—Draftsman and designer; one used to mining and marine work. State experience, age and salary required. Address Box 151, AM. MACH.

Wanted—A salesman for presses and dies, sheet metal working mchs., special mchs. for bicycles; state full particulars. Box 158, AMER. MACHINIST.

Wanted—Factory supt. for mch. shop at St. Louis mfg. hdwr. specialties, light mchy., dies, etc.; steady work for the right man. Box 157, AMER. MACH.

Wanted—A foreman capable of handling from 20 to 25 men, thoroughly experienced in fine machine tool work. Address, The Davis & Egan Machine Tool Co., Cincinnati, O.

Wanted—At once, a man to run four Hartford automatic screw machines. Must be capable of turning out very close work and of taking good care of the machines. Must be willing to work nights part of the time. Apply to Geo. B Woodruff, ast. supt., Wm. L. Gilbert Clock Co., Winsted, Conn.

Wanted—A first class, sober, reliable field foreman, to build tanks, smoke stacks, water towers, etc. Must be capable of estimating costs on field work and keeping his labor within estimate. Would be located in New York and used in that city and surrounding territory. Address, stating experience, etc., Field Work, care AM. MACH.

An old established company manufacturing air-brakes for surface cars requires the services of a qualified mechanical engineer. One preferred who has a knowledge of electricity. To a bright, self-reliant man this offers an exceptionally fine chance to secure a position which promises permanence and compensation increasing with applicant's worth and length of service. No mere theorists are desired. Only those able to furnish satisfactory references as to ability and character need apply. Communications will be regarded as confidential. They must include salary requested in order to command attention. Box 163, AMERICAN MACHINIST.

Miscellaneous Wants.

Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d h'd lathes & planers. S.M. York, Clev'd, O.

Calipers & Gauges. F.A. Welles, Milwaukee, Wis.

The Dutton Wet Twist Drill-Grinder is sold by the Garvin Machine Co., New York City.

Best and cheapest Bolt Header, made by Baush & Harris Machine Tool Co., Springfield, Mass.

Models, experimental and small special machy. built. Write to Crocker & Lawson, Binghamton, N. Y.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Boye, Cincinnati, O.

For Sale—Small lot aluminum, at three-quarter price; mostly full sheets. Write for list. Machinist, 138 East Sixteenth Street, New York.

We make a specialty of Shartle's patent safety set collars. Prices low and samples free. Middletown Machine Co., Middletown, Ohio.

Wanted—Every reader of this paper to send 35 cents for The Tool Catalogue. See Montgomery's advertisement on page 38 of this edition.

Two H.P. Baxter engine and boiler, good order, or iron planer to exchange for foot or power engine lathe. B. F. Grout, East St. Johnsbury, Vt.

Model Locomotives—Complete castings, latest N. Y. Cen. standard, up to date; 4c. in stamps for catalog. G. H. Olney, 163 Herkimer St., Brooklyn, N. Y.

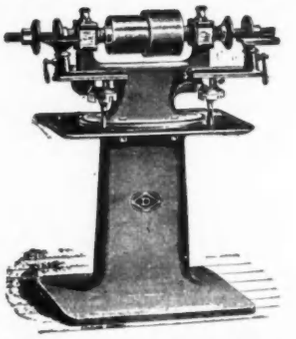
For Sale—Garvin No. 2 screw mach. wire fd., tools, fixtures, chuck: also B. & S. No. 2 U.M. mach., large stock cutters, mach. new, Jan. Box 130, AM. MACH.

Wanted—An Idea. Who can think of some simple thing to patent? Protect your ideas; they may bring you wealth. Write John Wedderburn & Co., Patent Attorneys, Washington, D. C., for their $1,800 prize offered to inventors.

Wanted—$3,000 for thoroughly equipped repair mch. shop and wrench fty.; cost $8,000; town of 10,000; 17 factories; good farming country. New mchy. (Lodge & Davis); doing good bus.; must be sold at once. Vandegrift Mfg. Co., Shelbyville, Ind.

Business Opening—Foundry and machine business in East Tenn. A rare optnty. for a bus. man, machinist or molder wishing to go south; only bus. of kind in growing mfg. city of over 4,000 population; reason for selling wish to engage in another line of bus. For further particulars ad. Box 101, Harriman, Tenn.

Wanted—To correspond with parties having article of manufacture now made on contract which could be further developed under the favorable conditions we have to offer. Would also like to hear from firm open to change whereby an established bus. may be increased. Cheap power and low rents, or increased capital if investigation warrants. Confidental. Address, Board of Trade, care AM. MACH.



GRINDING MACHINERY.

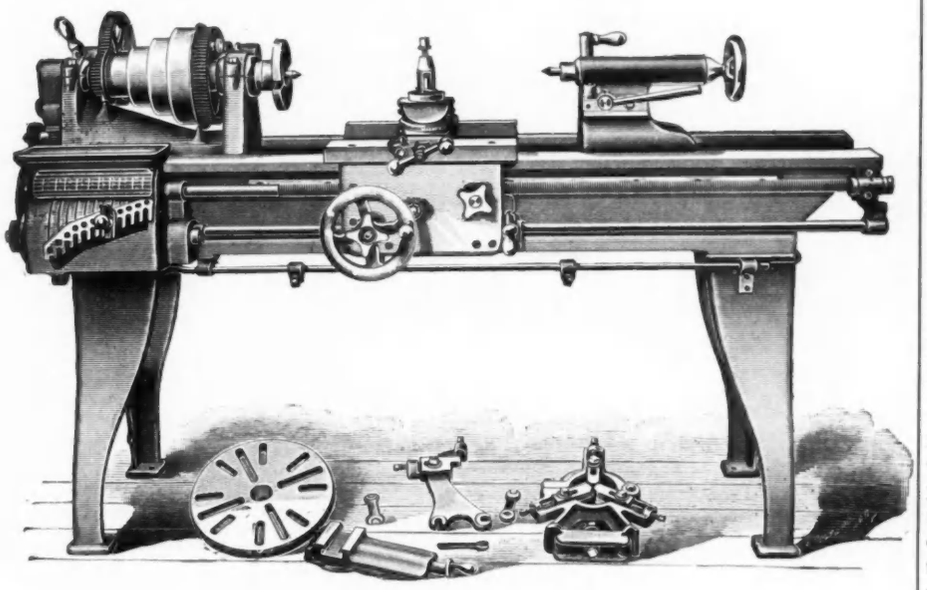
There are other Grinders on the market. Anybody can make one, and make a good one, if he puts work enough on it. But there has never been one made that would stand the test of hard wear like ours, because we make it on the right principle, cast-iron Engine Lathe Boxes, and a Dust Proctector that protects. It is expensive construction, but our customers have used it for years and years, and like it. You will too. Write to us.

DIAMOND MACHINE CO.

PROVIDENCE, R. I., and CHICAGO, ILL.

London Agents, CHAS. CHURCHILL & CO., Limited.
Paris Agents, FENWICK FRERES,
Berlin Agents, SCHUCHARDT & SCHUTTE.
Copenhagen Agent, V. LOWENER.

THIS LATHE COMBINES THE LATEST AND BEST IMPROVEMENTS.



14 in. x 6 ft. Hendey-Norton Lathe

With Improved Automatic Stop.

• • •

AUTOMATIC STOP

It is durable, simple, indispensable. It will automatically stop the carriage in either direction. It is equally efficient whether feeding or thread-cutting, running up to a shoulder, boring to bottom of holes, or internal thread-cutting. No danger of spoiling either tool or work. It is a safeguard against accidents in either direction.

CARRIAGE

The carriage reverses in apron; no slamming of countershaft. There is no comparison between this lathe and the old style or common lathe.

THREADS

It has all threads in daily use with simple movement of lever.

FEEDS

Has all feeds in daily use with simple movement of lever. Send for Circular.

• • •

THE HENDEY MACHINE COMPANY,

Torrington, Conn.

Agents for the Pacific Coast, PACIFIC TOOL AND SUPPLY CO., San Francisco, Cal.

European Agents, CHAS. CHURCHILL & CO., Ltd., London and Birmingham. SCHUCHARDT & SCHÜTTE, Berlin and Vienna. EUGENE SOLLER, Basel, Switzerland.

(Continued from page 34.)

present time, there is a great deal more business being done, the only cause for complaint being the ruling low prices. In nearly all lines this seems to be the case and manufacturers are of the opinion that better prices will not be had until late summer or early fall.

The collapse of the iron ore pool has not tended to improve the situation, but, on the contrary, it is feared that low ore prices will serve to keep business back for a time at least. It is well understood that the market must prepare for cheap ore and a basis may the sooner be reached.

In the machinery lines, business is gradually improving. Some of the larger machine dealers report quite an active demand. The Sherriff Machinery Company states that it has done more business within the last two months than it did for the last five months of 1896. The U. Baird Machinery Company has also been pretty busy within the past month. This company did a large export business last year. Inquiries are very numerous, coming in by almost every mail. If a portion of these could only be closed during April, the month's business would make an extremely good showing.

In rolling mill machinery, there has been some business done and the prospects are very bright, as there are several large contracts pending now which call for a considerable amount of heavy machinery. The contracts for the new Braeburn Steel Company, of this city, have nearly all been let, while as yet nothing has been done regarding the new tin plate plant to be erected here by the National Tin Plate Company, of Anderson, Ind., except as to the construction of the main building, which has been awarded to the Shiffler Bridge Company, of this city. There is also talk of several new enterprises to be started in this vicinity during the spring.

Electric light and water works systems are being installed rapidly. Numerous establishments are placing their own light plants and companies are being organized almost daily to supply water for all purposes.

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Quotations.

NEW YORK, Monday, April 5.

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$12 00 @ $12 50
No. 2 foundry, Northern	11 25 @ 11 75
No. 2 plain, Northern	10 50 @ 10 75
Gray Forge	10 25 @ 10 50
No. 1 foundry, Southern	11 00 @ 11 25
No. 2 foundry, Southern	10 25 @ 10 75
No. 3 foundry, Southern	10 00 @ 10 25
No. 1 soft, Southern	10 50 @ 10 75
No. 2 soft, Southern	10 25 @ 10 50
Foundry forge, or No. 4, Southern	9 75 @ 10 25

The lower figures quoted are said to be under the general market.

Bar Iron—Base—Mill price, in carloads, on dock: Common, 1.00 @ 1.10c.; refined, 1.10 @ 1.25c. Store prices: Common, 1.25 @ 1.40c.; refined, 1.40 @ 1.50c.

Tool Steel—Ordinary sizes, standard quality, 6 @ 7c., with some brands perhaps a little less; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel — Ordinary brands, from store, in small lots, 1.50 @ 1.60c.

Cold Rolled Steel Shafting—Base size, 2.50 @ 2.55c., in small lots, from store.

Copper—Carload lots, Lake Superior ingot,

11¾c., dull; electrolytic, 11⅛ @ 11¼c.; casting copper, 11 @ 11⅛c.

Pig Lead—In carload lots, 3.40c., f. o. b.

Pig Tin—For 5 and 10-ton lots, 13.25 @ 13.30c., f. o. b.

Spelter—In carload lots, New York delivery, 4.10 @ 4.20c., f. o. b.

Antimony—Cookson's, 7⅜ @ 7½c.; Hallett's, 6¾ @ 7c.

Lard Oil—Prime city, present make, commercial quality, in wholesale lots, 39 @ 41c.

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New Catalogs.

There are three sizes of Standard Catalogs, first authorized by the Master Car Builders' Association, 9" x 12", 6" x 9" and 3½" x 6". We recommend the 6" x 9" size for machinery catalogs. When they must be larger or smaller, one of the other standard sizes should be adopted if possible.

The St. Louis Iron & Machine Works, St. Louis, Mo., send us a catalog devoted to the description and illustration of the "St. Louis Corliss" engine. Engravings of parts of this engine are given, and the catalog is standard size, 6 x 9 inches.

The Otto Gas Engine Company, Philadelphia, Pa., have issued a catalog, which contains illustrations and description of the Otto marine engine. Pictures of yachts and launches fitted with these engines are given. The catalog is 7 x10¼ inches.

We have received from Taylor, Taylor & Hobson, Leicester, England, a catalog containing illustration and description of an engraving machine, for lettering on metals or other materials. Examples of work done by the machine are included, and the catalog is 5 x 8 inches.

Landis Bros., Waynesboro, Pa., send us "A Treatise on the Construction and Use of Universal and Plain Grinding Machines." Descriptions and illustrations of various styles of grinding machines are included, and for those interested in this class of machinery this book contains much useful information. It is standard size, 6 x 9 inches.

Taylor, Wilson & Co., Limited, Allegheny, Pa., send us a catalog illustrating various forms of machine-molded gearing. On one page of this catalog they have marked an engraving and their recommendation of short-toothed spur gears. These, it seems are regularly made by this concern, and they recommend them as being in every way superior, especially for heavy work. The catalog contains a number of useful tables and considerable information on subjects connected with gearing and the transmission of power. It is 4¾ x 8½ inches.

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Manufactures.

Sidney Lascelles, Fitzgerald, Ga., will place new machinery.

At Gardiner, Me., J. F. Newell & Co. will erect a brass foundry.

Messrs. Ranger & Babson, Bangor, Me., will place new machinery.

At Armordale, Mo., the Diamond Glue Company will erect a glue factory.

The Avondale Mills Company, Birmingham, Ala., will erect a factory soon.

Messrs. Weidig & Co., Zanesville, O., have decided to enlarge their foundry.

The Riverhead Electric Light Company, Brooklyn, N. Y., is enlarging its plant.

Messrs. Fair and Day, of Knoxville, Tenn., will erect another addition to their plant.

At Belleville, Ill., John Isselhardt and John Scheer will erect a boiler and repair shop.

The Chattanooga (Tenn.) Pulp Mills Company is contemplating the enlargement of its plant.

The Horton Chuck Company, of Windsor Locks, Conn., will erect an addition to their shops.

Columbia University
in the City of New York.

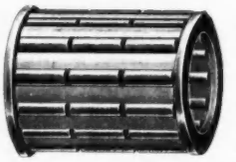
SCHOOL OF MINES,
SCHOOL OF CHEMISTRY,
SCHOOL OF ENGINEERING,
SCHOOL OF ARCHITECTURE,
SCHOOL OF PURE SCIENCE.

Four years' undergraduate courses and special facilities for graduate work in all departments. Circulars forwarded on application to the Secretary of the University.

THE BEST MECHANICS use COLUMBIA CALIPERS
THERE'S A LITTLE BOOK—TELLS WHY
E. G. SMITH, COLUMBIA, PA.

FOR ADVERTISEMENT OF
TIGHT JOINT CO. NEW YORK,
See Issue of April 1, 1897.

To Builders of Machinery.



Do you know that

HUB ROLLER BEARINGS

will make your machines run 50 per cent. easier? Besides, they cannot heat and will outwear many sets of babbitt boxes.

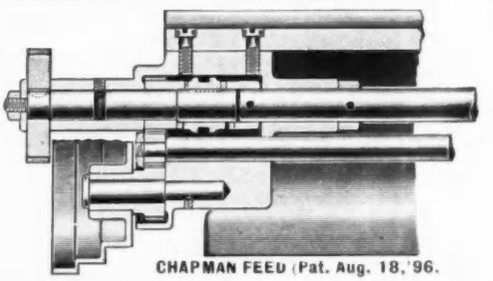
THE BALL BEARING COMPANY,

SEND FOR ILLUSTRATED CATALOGUE.
10 Watson Street, BOSTON, MASS.

HIGH GRADE MILLING MACHINES,

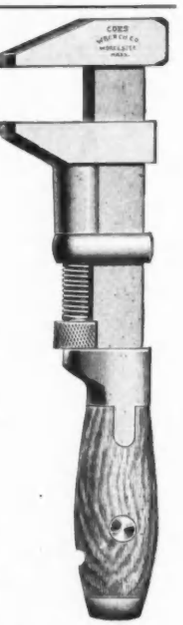
In Various Sizes; equal to any made.
KEMPSMITH MACHINE TOOL CO.,
Milwaukee, Wis., U. S. A.
ANY OF OUR AGENTS CAN TELL YOU OF THEIR GOOD POINTS.
J. J. McCABE, New York.
THE FAIRBANKS CO., Philadelphia, Pa.
STRONG, CARLISLE & TURNEY CO., Cleveland, Ohio.
SELIG, SONNENTHAL & CO., London, Eng.

FITCHBURG
MACHINE WORKS,
FITCHBURG, MASS., U.S.A.
The BEST LATHE FEED to-day is used on the
FITCHBURG LATHE.
Double End Clutch slightly moved to the left or middle to respectively engage roughing or finishing feed, and to right to connect for screw cutting.
USERS PRAISE IT. CATALOG E.



CHAPMAN FEED (Pat. Aug. 18, '96.

L. COES'
Genuine Improved
Knife Handle Patent
Screw Wrenches
Manufactured by
Coes Wrench Co., Worcester, Mass.



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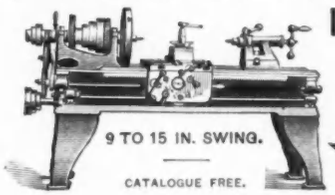

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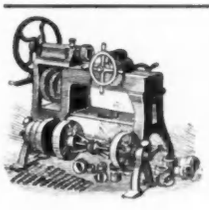

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The Manitowoc Steam Boiler Works, Manitowoc, Wis., will make additions to its plant shortly.

At Pembroke, Ont., the Canadian Pacific Railroad will erect new shops, at a cost of about $30,000.

The plant of A. P. Stoddard & Co., machinists, Gloucester, Mass., was recently destroyed by fire.

William B. Scholes & Sons, Philadelphia, Pa., will make an addition to their plant at an early date.

The Buffalo Furnace & Machine Company, of Buffalo, N. Y., will make some additions to their machinery.

The Standard Boiler Works, of Chicago, Ill., have decided to change its location, and will move to Goshen, Ind.

At Watertown, Mass., the Walker & Pratt Foundry Company have commenced the erection of a new foundry.

The Newcastle Traction Company, Newcastle, Pa., is about to commence the erection of a new machine shop.

Work on the new plant of the United States Seamless Tube Company, McKeesport, Pa., is progressing favorably.

At Camden, N. J., the Robinson & Martin Manufacturing Company has been formed, with capital of $100,000.

The Hawley Down Draft Furnace Company, recently incorporated, will establish a factory at once at Detroit, Mich.

At Augusta, Ga., The John P. Manufacturing Company will erect a new mill. Mr. Charles Estes is president.

The Jefferson Manufacturing Company, Jefferson, Mass., are to make an addition to their plant at an early date.

New machinery will be installed in the Dudley refrigerator plant at Owosso, Mich. Mr. E. F. Dudley is proprietor.

At Duquoin, Ill., a new manufacturing establishment is in prospect, for the purpose of making the G. W. T. Seiffert dust collector.

The Indianapolis Engine Company, Indianapolis, Ind., are fitting up an establishment, in which they wil manufacture a line of stationary engines.

A sugar refinery will be erected at Long Island City, N. Y. Mr. Claus Doscher, formerly president of the Brooklyn Sugar Refining Company, is interested.

The Woodward mine of the Delaware, Lackawanna & Western Railroad, at Kingston, Pa., is about to be equipped with an electric haulage system by the General Electric Company.

Messrs. J. J. Mullaney and R. H. Richards are partners in the Cooke Machinery Company, of New York City, which company will succeed the Cooke Company. Mr. J. J. Mullaney is president, the office being located at 165 Washington street.

P. F. Olds & Son, Lansing, Mich., builders of gasoline engines, have recently completed a 60 x 150 feet addition to their plant, which is the last of a series of additions resulting from a very modest start in business twelve years ago. Contrary to general business, they report having experienced no depression of trade during the past four years.

The H. W. Johns Manufacturing Company, who have been located at 87 Maiden lane for the past twenty-five years, have found it necessary to move to more commodious quarters, and will remove shortly to the new Woodbridge Building, at William, John and Platt streets. The office will occupy the ground floor, and will be fitted up in handsome and modern style. The basement will also be occupied with stock.

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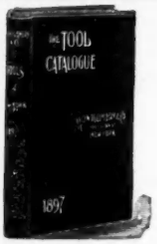

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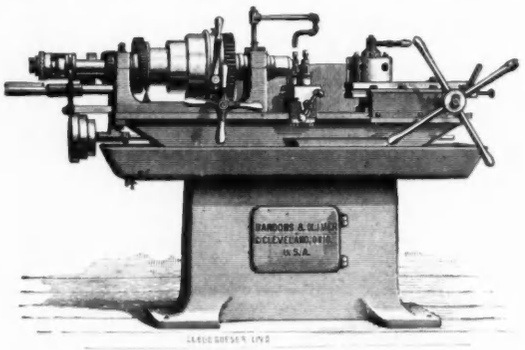

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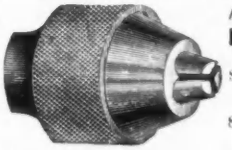

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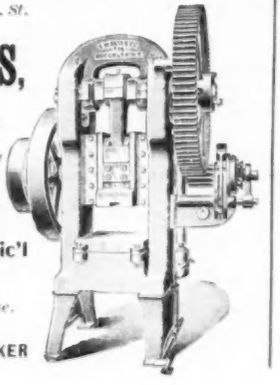

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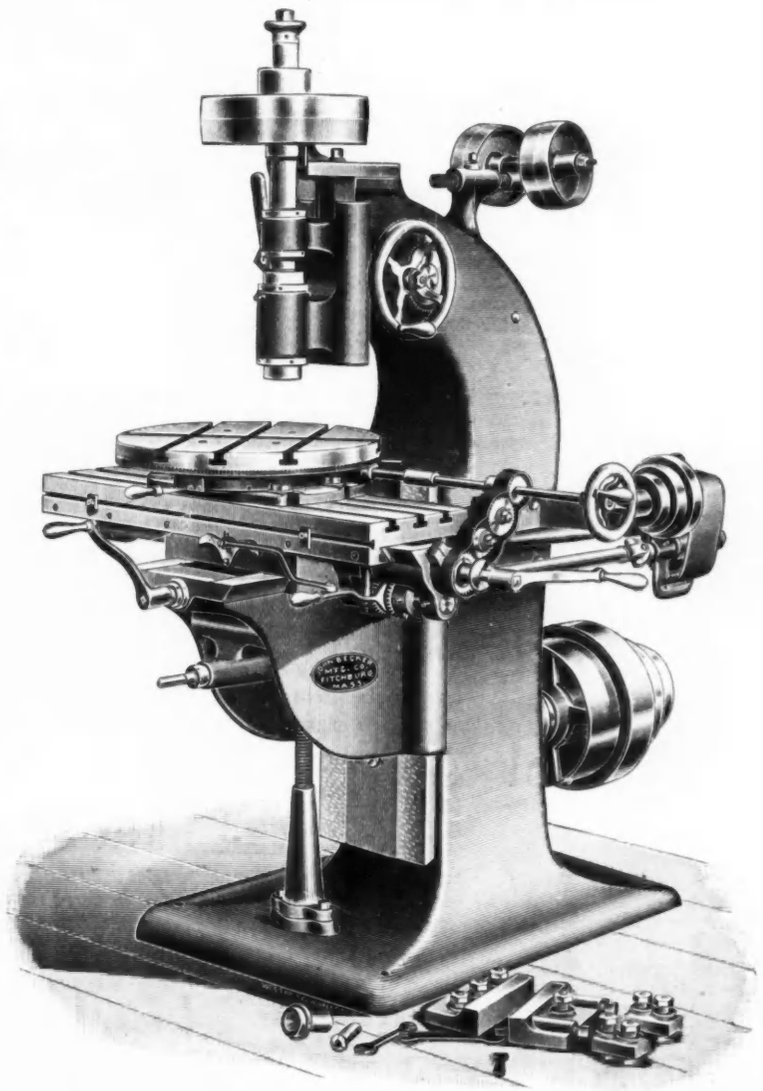

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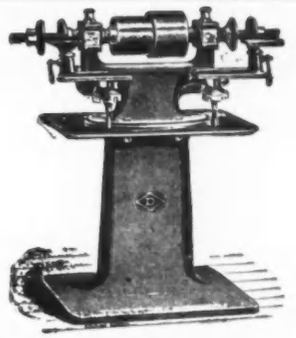

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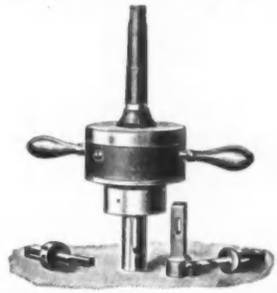

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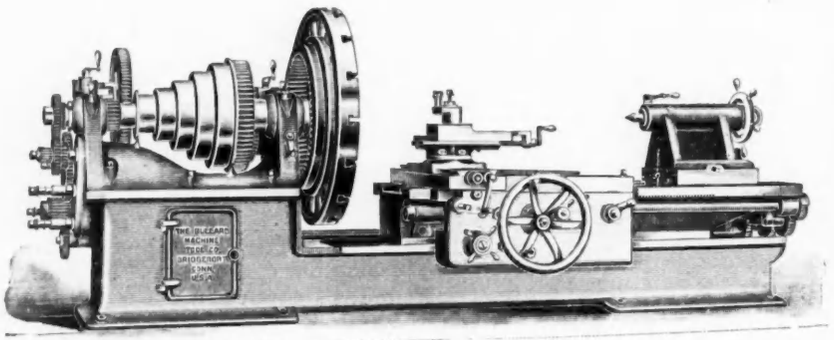

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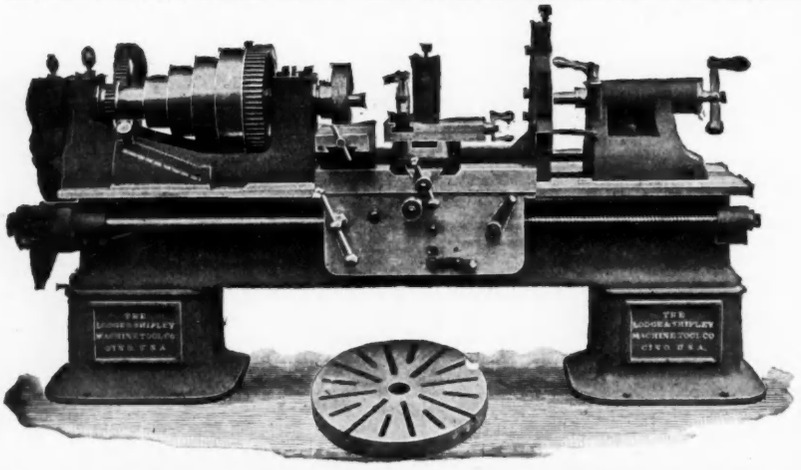

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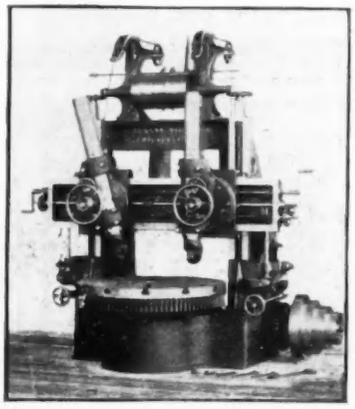

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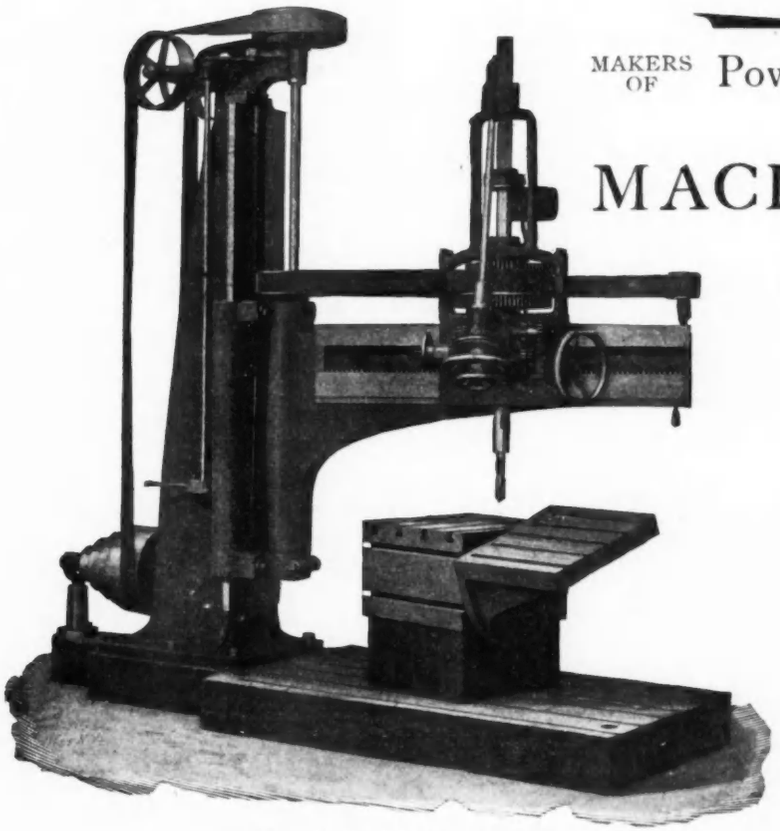

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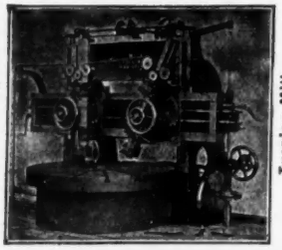
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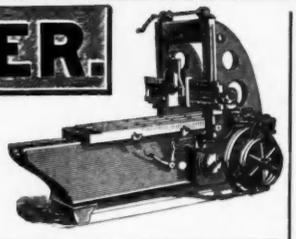

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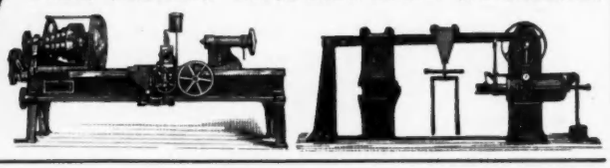

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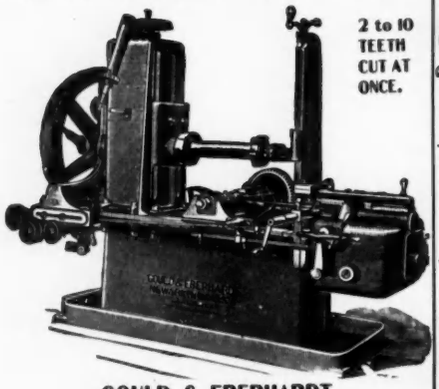

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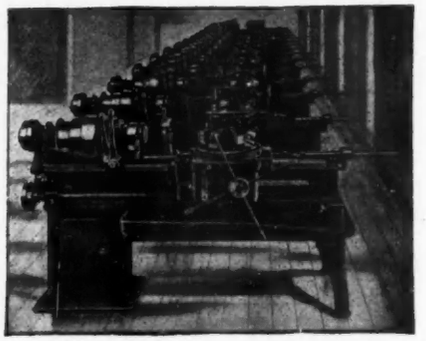

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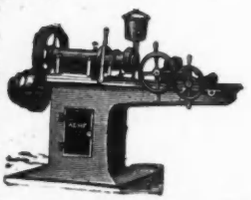

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